FIELD
ENGINEERING CO., INC.
CONSULTING ENGINEERS

110 Industrial Drive, P.O. Box 1178
Mattapoisett, Massachusetts 02739
Telephone: (508) 758-2749
Facsimile: (508) 758-2849

March 17, 2021
Project No. 2312

Mr. Stephen Seredynski, Chair
Northfield Planning Board
69 Main Street
Northfield, MA 01360

RE: Response to Consultant Comments
Proposed Pine Meadow Road Solar Array "B"
BWC Pine Meadow Brook LLC
Off Pine Meadow Road, Northfield, Massachusetts

Dear Board Members:

Field Engineering Co Inc. ("FEC") and BWC Pine Meadow Brook LLC ("BWC") has received the review comment letter dated February 8, 2021 prepared by Beacon Integrated Solutions related to the above referenced project and has prepared the following response narrative and supporting documentation for consideration by the Board. Section headings and numbering correspond to the numbering in the Beacon Letter.

BEACON COMMENT: Agricultural Covenant-Beacon recommends that in connection with its application for a Building Permit, the Planning Board should require The Applicant to provide proof of release of the parcels under review in this application.

FEC/BWC RESPONSE: The Agricultural Covenant was released on February 15th, 2021, please see Exhibit A for the recorded release.

BEACON COMMENT: Building Permit-Section 11.08.03.02 Beacon recommends that The Applicant provide final construction drawings to the Planning Board, stamped by a licensed professional engineer register in MA prior to seeking a Building Permit.

FEC/BWC RESPONSE: The Applicant agrees to provide to the Planning Board final construction drawings, stamped by a licensed professional engineer registered in MA prior to submitting and application for a Building Permit.

BEACON COMMENT: Site Plan Review - (2) Required Documents - (a) Site Plan showing – iii. Locations of wetlands and Priority Habitat Areas. - Beacon recommends that The Applicant file a Notice of Intent with NHESP to confirm the non-existence of native species listed as endangered, threatened or of special concern.

FEC/BWC RESPONSE: Based on the MA OLIVER GIS analysis, the project area is not within the NHESP Priority Habitats of Rare Species or NHESP Estimated Habitats of Rare Wildlife. Please see Exhibit C – NHESP Endangered Species Analysis.

BEACON COMMENT: Site Plan Review - (2) Required Documents - (a) Site Plan showing – vi. List of hazardous materials:

(1) Beacon recommends that The Applicant provide detailed operations, maintenance and remedial procedures to address issues pertaining to fluid release and impact on vegetation and stormwater.

FEC/BWC RESPONSE: See response below to: BEACON COMMENT Site Plan Review - (5) Design and Performance Standards - (g) Hazardous Materials.

(2) Further, Beacon recommends that The Applicant provide more detailed information on the proposed battery storage and containment equipment, in addition to the HVAC equipment. Specifically, The Applicant should provide documentation on the fluids contained in these systems in addition to the fire suppression systems to be used.

FEC/BWC RESPONSE: The Applicant provides Exhibit D- Sungrow ST3727kWh Energy Storage Systems Specifications, which details the proposed Samsung battery storage system and HVAC containment equipment. The Sungrow HVAC system proposed is a forced air cooling system that utilizes air conditioning units located on the ends of the container, with a total of 4 units per container, as seen in Exhibit E- ST3727kWh system noise test report. This HVAC system is used to maintain consistent temperatures, and is similar to the heating and cooling equipment used for a typical building. Historically, HVAC systems used the Freon (R-22) refrigerant fluid to cool, but this was banned as of January 1, 2020. R-22 has now been replaced by a R-410A (also called Puron), which is an Alkyl Halide refrigerant that does not contribute to ozone depletion.

The containment system also includes a FM-200 fire suppression system. FM-200 (HFC-227ea) leaves no residue and does not require clean up after deployment. FM-200 is a liquified gas stored as a liquid on site in a container and turns to a vapor when discharged to disrupt the combustion reaction to extinguish the fire. More information on FM-200 is provided in Exhibit F- FM-200 Material Safety Data Sheet.

BEACON COMMENT Site Plan Review - (2) Required Documents - (a) Site Plan showing – x. Name, address and contact information of the installer- Beacon recommends that The Applicant identify and provide all required information to the Planning Board in connection with its application for a Building Permit.

FEC/BWC RESPONSE: The Applicant agrees to provide the Planning Board with all required information in connection with its application for a Building Permit.

BEACON COMMENT Site Plan Review – (2) Required Documents - (c) – O & M Plan

(1) Beacon recommends that the Planning Board Condition the Special Permit with the requirement that The Applicant provide year-round access to the concrete equipment pad and the overall system, including providing the Town on an annual basis with adequate documentation addressing snow removal services on the gravel access road.

FEC/BWC RESPONSE: The Applicant agrees to clear any snow from roads within 24 hours of a snow event exceeding 4".

(2) Beacon further recommends that in connection with its jurisdictional review of the Notice of Intent to be filed with the Northfield Conservation Commission, a review of the proposed annual O&M Stormwater Management Systems plan should be evaluated for best management practices.

FEC/BWC RESPONSE: The Applicant agrees to provide the Planning Board with the proposed O&M Stormwater Management System plans for Best Management Practices.

BEACON COMMENT Site Plan Review – (2) Required Documents - (f) – Proof of Liability Insurance: Beacon recommends that the Planning Board seek guidance from the Town's insurance agent with regards to the limits of coverage.

FEC/BWC RESPONSE: The Applicant awaits feedback from the Town's insurance agent.

BEACON COMMENT Site Plan Review - (2) Required Documents – (g) – Financial Surety:

(1) Beacon recommends that the Planning Board request The Applicant to reconsider its projected cost estimate and provide supporting documentation of actual decommissioning costs for projects owned by The Applicant of similar size.

FEC/BWC RESPONSE: The Applicant has provided a decommissioning summary by Field Engineering, which has been signed and stamped. This calculation to determine removal costs has been broadly accepted across Massachusetts for solar projects. Please see table below for examples of previously approved solar projects decommissioning estimates.

Project	Total Bond Amount (Present)	System Size (MWDC)	Cost/MW (Present)
Town of Palmer Sykes Solar Project	**$187,500**	**8.561**	**$21,902**
Town of Mattapoisett Solar Project	**$142,500**	**6.56**	**$21,723**
Town of Wilbraham Solar Project	**$94,900**	**4.4**	**$21,568**

(2) Beacon recommends that the form of Financial Surety be an annual renewing irrevocable Bond with the Town of Northfield as the named bond holder.

FEC/BWC RESPONSE: The Applicant requests for the Planning Board not to specify the form of financial surety as a condition. The Applicant is willing to provide to the Planning Board the form of financial surety before a building permit is requested for the Board's approval.

BEACON COMMENT Site Plan Review - (5) Design and Performance Standards - (c) Signage Beacon recommends that The Applicant or its Asset Manager/Operator provide a number that is available 24/7/365 to address emergency concerns. This is particularly important for Public Safety personnel.

FEC/BWC RESPONSE: The Applicant agrees to provide its Asset Manager/ Operator a number that is 24/7/365 available to address emergency concerns.

BEACON COMMENT Site Plan Review - (5) Design and Performance Standards - (f) Control of Vegetation. Beacon recommends that the Planning Board Condition the Special Permit by prohibiting the use of any chemicals, herbicides or pesticides within Array B and in all portions of the parcels under the Applicant's control.

FEC/BWC RESPONSE: The Applicant requests that the Board provide further detail as to its concerns regarding use of common chemicals, herbicides, or pesticides. The Applicant will only use agricultural materials (fertilizers and pesticides) for the agricultural use in compliance with applicable laws.

BEACON COMMENT Site Plan Review - (5) Design and Performance Standards - (g) Hazardous Materials

(1) Beacon recommends that The Applicant provide detailed operations, maintenance and remedial procedures to address issues pertaining to fluid release and impact on vegetation and stormwater.

FEC/BWC RESPONSE: In the event of fluid release of hazardous material during the construction, operation, or decommissioning of the solar project, The Applicant shall notify MassDEP in accordance with Massachusetts Contingency Plan (310 CMR 40.00), retain a Licensed Site Professional (LSP) and work with MassDEP officials for guidance. A contingency plan shall be implemented in the event of the release of hazardous materials under the following measures:

a. Equipment necessary to attend to inadvertent spills or leaks shall be stored on site in a secure and accessible location. Such equipment shall include, but not limited to: safety goggles, protective gloves, water and chemical fire extinguishers, sand, shovels, suitable absorbent materials, storage containers, and first aid equipment

b. Hazardous fluid releases shall be treated properly according to material type, volume of spill and location of spill to prevent further spillage and containment to the smallest area possible. Removal of the release fluid shall be done in an environmentally friendly manner and any damaged environment shall be remediated.

c. For large spills Mass DEP Hazardous Waste Incident Response Group will be notified immediately at 617-792-7653 and an emergency contractor shall be engaged.

Additionally, any procedures to address issues related to impacts on vegetation and stormwater will be detailed in the Stormwater Pollution Prevention Plan (SWPPP) filed prior to construction.

(2) Further, Beacon recommends that The Applicant provide more detailed information on the proposed battery storage and containment equipment, in addition to the HVAC equipment. Specifically, The Applicant should provide documentation on the fluids contained in these systems in addition to the fire suppression systems to be used.

FEC/BWC RESPONSE: Materials in the lithium-ion battery storage component include Cobalt Oxide, Manganese dioxide, Nickel oxide, Carbon, Polyvinylidene fluoride, and aluminum foil. Quantity and first aid measures are provided in Exhibit G- Samsung Materials specifications, to this response.

BEACON COMMENT Site Plan Review - (5) Design and Performance Standards - (h) Noise.
Beacon recommends that the Planning Board require The Applicant to provide a noise study of the combined solar photovoltaic array equipment and associated battery storage system demonstrating dBA levels at the boundary of the property.

FEC/BWC RESPONSE: Noise levels from the battery storage system will be generated by the HVAC system to heat and cool the storage container. Sungrow conducted a noise study for the ST3727kWh battery storage system proposed, and the study and results are provided in Exhibit E- Sungrow Noise Study. Noise volumes are the greatest at the end of the container, where the air conditioning systems are located. Maximum noise levels are 63.8 dBA at a distance of 1 meter and 56.4 dBA at a distance of 5 meters at each end of the system. From the side of the system, maximum noise levels are 56.3 dBA from a 5 meter distance, and 51.7 dBA at a 1 meter distance. The battery storage system is located approximately 130 Feet from the nearest property line and over 1,000 Feet from the nearest residence. The solar system will produce noise from its inverters at a noise level of 73 dBA from 10 feet away from the inverters and 43 dBA 100 feet away from the inverters. Please see Exhibit H and Exhibit I for inverter specifics. For reference, a noise level of 60-70 dBA is the equivalent of a business office environment, or a normal conversation, and a noise level of 55 dBA is equivalent to a household refrigerator.

BEACON COMMENT Site Plan Review - (6) Safety and Environmental Standards - (a) Emergency Services

(1) Beacon recommends that prior to commissioning, The Applicant should provide the Town with a Safety Manual describing the components of Array B and detailing safe de-energizing procedures of all major components including inverters, battery systems and modules. While it is not expected such detailed de-energizing procedures will be required, such information would prove beneficial in the event of a significant emergency.

FEC/BWC RESPONSE: The Applicant agrees to provide the Town with a Safety manual detailing the safe de-energization of all major components prior to commissioning. The Applicant requests the Board's guidance as to which Town department should receive the manual.

(2) Beacon recommends that the Planning Board Condition the Special Permit with the requirement that the Town be noticed on any assignment, transfer or sale of BWC Pine Meadow Brook LLC.

FEC/BWC RESPONSE: The Applicant agrees to provide notice to the Town of any assignment, transfer, or sale of BWC Pine Meadow Brook LLC.

BEACON COMMENT Monitoring, Maintenance and Reporting – Solar Photovoltaic Installation Conditions

(1) Beacon recommends that the Planning Board Condition the Special Permit with the requirement that The Applicant provide year-round access to the entire gravel access road, concrete equipment pad and the overall system, including providing the Town on an annual basis with adequate documentation demonstrating the provision for snow removal services on the gravel access road.

FEC/BWC RESPONSE: The Applicant agrees to provide year-round access to the entire gravel assess road and will perform snow clearing operations after any snow event of 4" or more.

(2) Beacon further recommends that in connection with its jurisdictional review of the Notice of Intent to be filed with the Northfield Conservation Commission, a review of the proposed annual O&M Stormwater Management Systems plan should be evaluated for best management practices.

FEC/BWC RESPONSE: The Applicant agrees to provide the Planning Board with the proposed annual O&M Stormwater Management Systems plan to confirm that best management practices as described by the DEP Stormwater Management Handbook are included prior to construction. The Applicant notes the obligation of the Northfield Conservation Commission to review and approve the Stormwater Management System plan as part of the Notice of Intent filing.

BEACON COMMENT Monitoring, Maintenance and Reporting – Modifications. Beacon recommends that the Planning Board Condition the Special Permit to require that any material modifications to Array, specifically as it relates to Array DC capacity, battery storage, changes to the size or location of the concrete equipment pad, and/or changes to the design of the utility interconnection as shown in the Site Drawings dated 12/28/2020, pages SP-1 and SP-2, among others, be immediately provided to the Planning Board for approval.

FEC/BWC RESPONSE: The Applicant agrees to provide the Planning Board with any material modifications to the final site drawings approved by the Board for approval as an amendment to this permit, prior to receiving building permit.

BEACON COMMENT Monitoring, Maintenance and Reporting – Annual Reporting Beacon recommends that the Planning Board require The Applicant to provide copies of any annual reports filed with the Massachusetts Department of Agriculture and Massachusetts Department of Energy Resources in compliance with SMART Program qualifications.

FEC/BWC RESPONSE: The Applicant agrees to provide the Planning Board with copies of annual reports filed with Massachusetts Department of Agriculture and Massachusetts Department of Energy Resources in compliance with SMART program regulations.

BEACON COMMENT Abandonment or Decommissioning – Abandonment Beacon recommends that the Planning Board require The Applicant and property owner to address Decommissioning Requirements in its Lease agreements and provide evidence of such obligations.

FEC/BWC RESPONSE: The decommissioning requirements of the Northfield Zoning By law supersede any requirement he Applicant has with the property owner to decommission the project at the end of its useful life or termination of the project. Due to the obligation from the town required decommissioning surety, he Applicant respectfully requests that the contract between he Applicant and landowners remains private.

BEACON COMMENT Financial Surety:

(1) Beacon recommends that the Planning Board request The Applicant to reconsider its projected cost estimate and provide supporting documentation of actual decommissioning costs for projects owned by The Applicant of similar size.

FEC/BWC RESPONSE: The Applicant has used industry accepted standards to determine decommissioning costs and does not recommend increasing the cost estimate. Please see FEC/BWC Response above to BEACON COMMENT Site Plan Review - (2) Required Documents – (g) – Financial Surety: (1)- for more details.

(2) Beacon recommends that the form of Financial Surety be an annual renewing irrevocable Bond with the Town of Northfield as the named bond holder.

FEC/BWC RESPONSE: The Applicant requests for the Town not to specify the form of financial surety for decommissioning. The Applicant agrees to provide the final form of financial surety to the Planning Board for approval before a Building Permit is requested.

We feel that we have adequately addressed the Consultant's comments with this letter and the attached documentation and look forward to further discussing this project with the Board at the next Hearing on March 18. Please do not hesitate to contact me should you have any questions or require any additional information.

Sincerely,
Field Engineering Co., Inc.

Richard R. Riccio III, P.E.
Project Manager

COMMONWEALTH OF MASSACHUSETTS
RICHARD R. RICCIO III
CIVIL
No. 45898
REGISTERED PROFESSIONAL ENGINEER
3/17/2021

cc: Beacon Integrated Solutions

Attachments

1. **Exhibit A- Agricultural Covenant Release**
2. **Exhibit B- Hoop House Bedded Pack Roof Example (Not applicable for Array B)**
3. **Exhibit C- NHESP Mapping**
4. **Exhibit D- Sungrow ST37272kWh Energy Storage System Specifications**
5. **Exhibit E- ST37272kWh system noise test report**
6. **Exhibit F- FM-200 Material Safety Data Sheet**
7. **Exhibit G- Samsung Battery Specifications**
8. **Exhibit H- Power Electronics Solar Inverter (HEC1500V) Information**
9. **Exhibit I- Power Electronics Solar Inverter (HEMK600V) Information**

Exhibit A-Agricultural Covenant Release

Bk: 7715 Pg: 266 Franklin County
Page: 1 of 3 03/01/2021 10:02 AM

RELEASE OF LAND from a NON-DEVELOPMENT COVENANT held by THE COMMONWEALTH OF MASSACHUSETTS

Whereas the Commonwealth is the holder of a Non-Development Covenant dated March 8, 2016, recorded in the Franklin County Registry of Deeds in Book 6863, Page 183 ("Covenant"), on land located in the Town of Northfield owned by Hopping Ahead, LLC;

Property Address: Pine Meadow Road, Northfield, MA

Whereas, the Senate and House of Representatives in the General Court assembled, by Chapter 224 of the Acts of 2018 ("Act"), which was duly enacted and approved on August 9, 2018, a copy of which is attached hereto as Exhibit A, authorized the Commissioner of the Department of Agricultural Resources to execute a certificate releasing to Hopping Ahead, LLC the land from the Covenant;

Now, therefore, all of the parcels included in the Covenant are hereby released of record from the Covenant by the Commissioner of the Department of Agricultural Resources.

As a condition of the Release, Hopping Ahead LLC has paid to the Department of Agricultural Resources the sum of $100,000.00. Money received by the Commonwealth for release of the Covenant under this section shall be held in trust by the Department, to be expended only to acquire new agricultural covenants.

Executed under seal this 11th day of February 2021.

THE COMMONWEALTH OF MASSACHUSETTS

BY: _____
John Lebeaux
Commissioner
Department of Agricultural Resources

COMMONWEALTH OF MASSACHUSETTS

Norfolk, ss. Feb. 15, 2021

On this 15 day of February, 2021, before me, the undersigned notary public, John Lebeaux, personally appeared, proved to me through satisfactory evidence of identification, which was personal knowledge, to be the person whose name is signed on the preceding or attached document, and acknowledged to me that he signed it voluntarily for its stated purpose as Commissioner of the Department of Agricultural Resources of the Commonwealth of Massachusetts, as the voluntary act of the said Commonwealth. This document was notarized remotely utilizing electronic video conferencing in real time pursuant to Chapter 71 of the Acts of 2021.

(official signature and seal of notary public)

Notary Public: _____

Print Name: Christine M Smith

My commission expires: 7/26/24

EXHIBIT A

Acts (2018)

Chapter 224

AN ACT RELEASING CERTAIN LAND IN NORTHFIELD FROM THE OPERATION OF AN AGRICULTURAL COVENANT.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same as follows:

SECTION 1. Notwithstanding any general or special law to the contrary, under section 22 of chapter 20 of the General Laws, the commissioner of agricultural resources shall execute a release of the agricultural covenant held by the commonwealth, acting on its behalf, on certain land in the town of Northfield owned currently by Hopping Ahead LLC, ("Landowner"). Title was acquired by a covenant recorded in Book 6863, Page 183, at the Greenfield Registry of Deeds

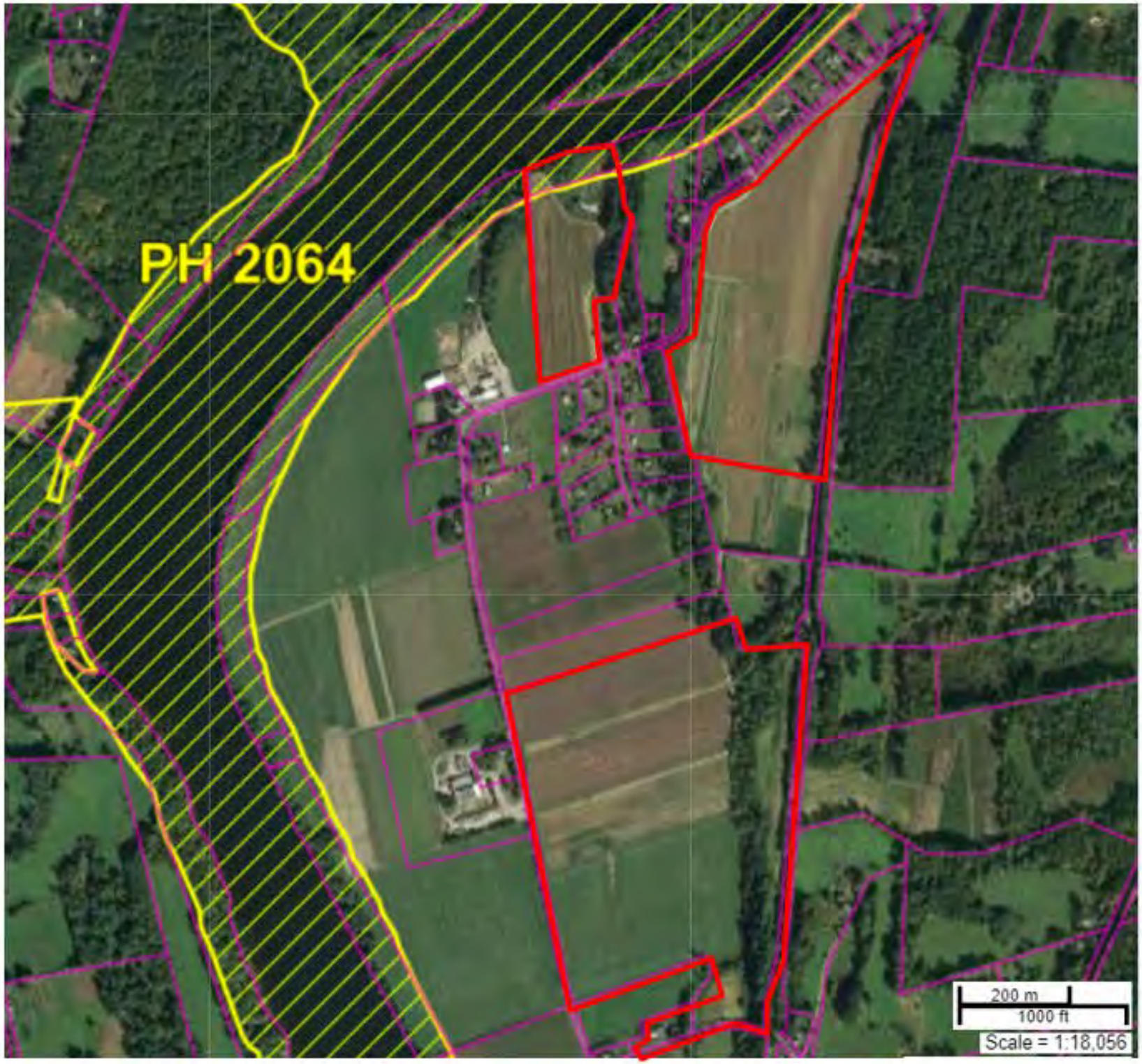
SECTION 2. As a condition precedent to the release authorized in section 1, the current landowner shall pay to the department of agricultural resources a monetary amount as determined by the commissioner, provided such sum shall not exceed the funds the landowner originally received as consideration for said covenant. Monies received by the commonwealth for said release under this section, shall be held in trust by the department, to be expended only for acquiring new agricultural covenants.

Approved, August 9, 2018.

Exhibit B-Hoop House Bedded Pack Roof Example (Not Applicable for Array B)

Exhibit C-NHESP Mapping

NHESP Endangered Species Analysis



NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

Exhibit D-Sungrow ST37272kWh Energy Storage System Specifications

SUNGROW

ST3727KWH(L)-D1250HV+ SG3600UD-MV Preliminary

Energy Storage System

HIGH INTEGRATION

- DC coupled energy storage system integrated with PV inverter
- Advanced integration technology ensures optimal system performance and lower cost

SAFE AND RELIABLE

- DC electric circuit safety management includes fast breaking and anti-arc protection
- Multi-state monitoring and linkage actions ensure battery system safety

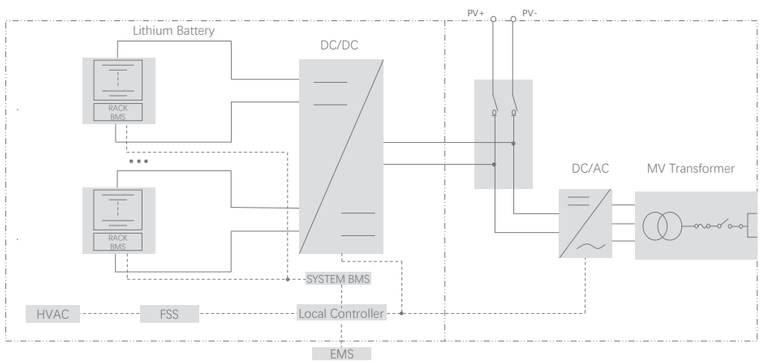
EFFICIENT AND FLEXIBLE

- Intelligent cell-level temperature control ensures higher efficiency and longer battery cycle life
- Modular design supports parallel connection and easy system expansion

SMART AND FRIENDLY

- Integrated local controller enables single point of communication interface
- Fast state monitoring and faults record enables pre-alarm and faults location

CIRCUIT DIAGRAM



Battery capacity will be configurable as client requirement

System Type	ST3727KWH(L)-D1250HV+SG3600UD-MV
PV Data	
Max. PV input voltage	1,500 V
MPPT voltage range for nominal power	915 ~ 1,300 V
Number of PV inputs	20(optional:22/24/26/28)
Max. PV input current	5,415 A
Battery Data	
Cell type	LFP , 280 AH
Configuration of system	416S10P
Battery capacity (BOL)	3,727 kWh
Battery voltage range	1,123.2 ~ 1,497.6 V
BMS communication interfaces	RS485, Ethernet
BMS communication protocols	Modbus RTU, Modbus TCP
DCDC Data	
Working voltage range	500 ~ 1,500 V
Nominal power	1,250 kW
Max. current	1,400 A
AC Data	
Nominal AC power	3,600 kW @ 45 ℃ (113 ℉) / 3,240 kW @ 50 ℃ (122 ℉)
Max.THD of current	< 3 % (at nominal power)
DC component	< 0.5 % In
Grid voltage range	12 – 35 kV
Power factor	> 0.99 (at nominal power)
Adjustable power factor	0.8 leading – 0.8 lagging
Nominal grid frequency	50 Hz /60 Hz
Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 50 – 65 Hz
Isolation method	Transformer
Transformer	
Transformer rated power	3,600 kVA
LV/MV voltage	0.63 kV / 12 ~ 35 kV
Transformer vector	Dy1 or Dy11
Transformer cooling type	ONAN (Optional: KNAN)
Oil type	Mineral oil (PCB free) or degradable oil on request
General Data	
Dimensions of PCS unit (W * H * D)	6,058*2,896*2,438 mm / 238.5"*114.0"*96.0"
Dimensions of battery unit (W * H * D)	12,192*2,896*2,438 mm / 480.0"*114.0"*96.0"
Weight of PCS unit	18,000 kg / 39,683.2 lbs
Weight of battery unit (with / without battery)	46,300 kg 102,074.0 lbs / 16,300 kg 35,935.3 lbs
Degree of protection	NEMA 3R
Operating temperature range	-30 to 50 ℃ / -22 to 122 ℉ (> 45 ℃ / 113 ℉ derating)
Relative humidity	0 – 95 % (non-condensing)
Max. working altitude	1000 m (standard) / > 1000 m (optional) (3280.8 ft (standard) / > 3280.8 ft (optional))
Cooling concept of battery chamber	Heating, Ventilation and Air Conditioning
Cooling concept of PCS chamber	Temperature controlled forced air cooling
Fire suppression system of battery unit	FM200 extinguishment system
Communication interfaces	RS485, Ethernet
Communication protocols	Modbus RTU, Modbus TCP, IEC 104
Compliance	UL9540, UL9540A, UL1973, UL1741+SA, IEEE1547

Exhibit E-ST37272kWh system noise test report

ST3727KWH（L）Container noise test report

1. Test overview and results

The ST3727KWH(L) container has a total length of 12.2m, a width of 2.3m, and a height of 2.8m. The container contains 4 air conditioners with a cooling capacity of 30kW, which are distributed at both ends of the container and are the main noise source of the system. In this test, three points 1m, 3m, and 5m away from the container and a vertical height of 1.5m were selected for testing. The environmental noise was 49.7dB. The specific test results are shown in the figure below.

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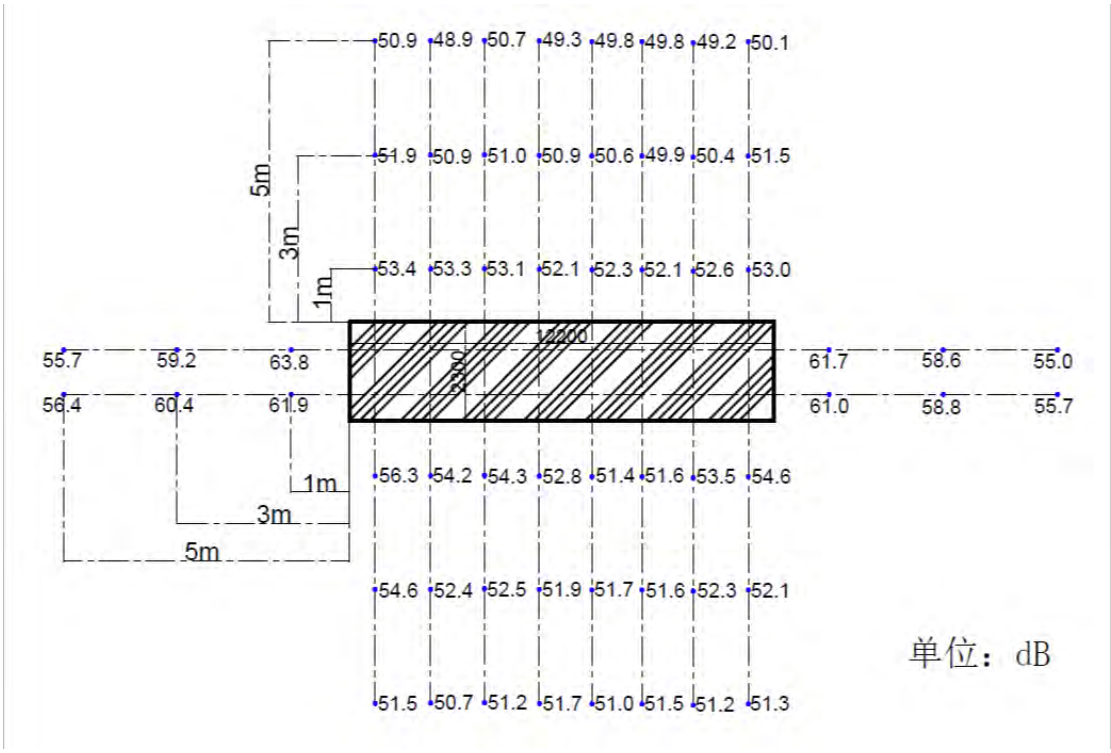

Fig 1. Test result graph

2. Test details

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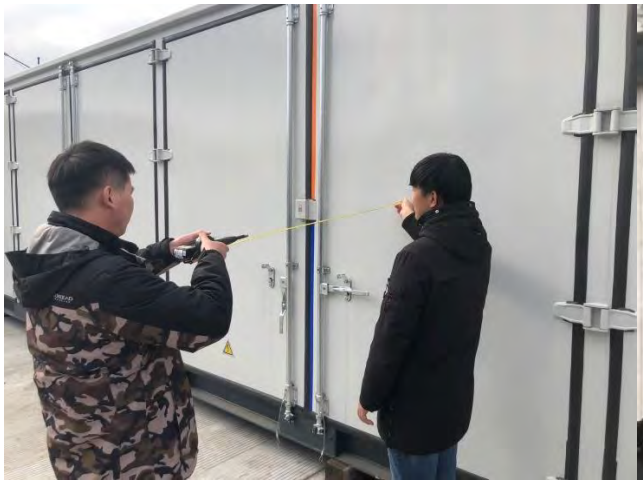


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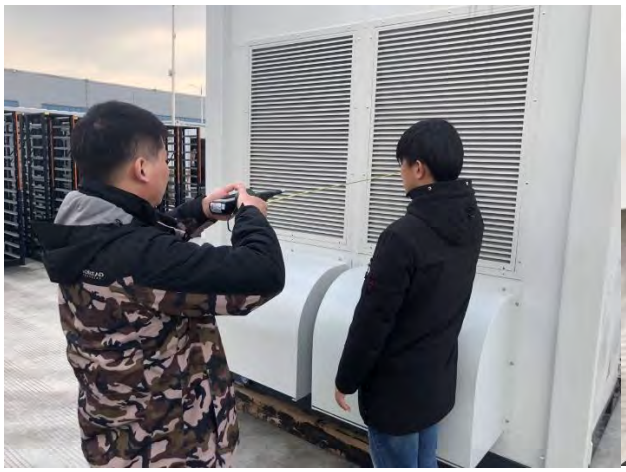

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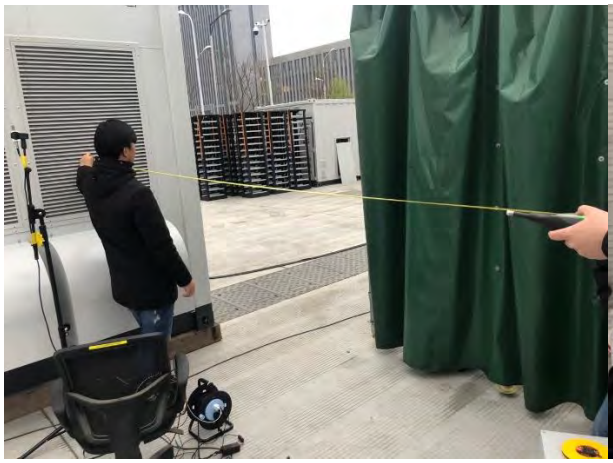

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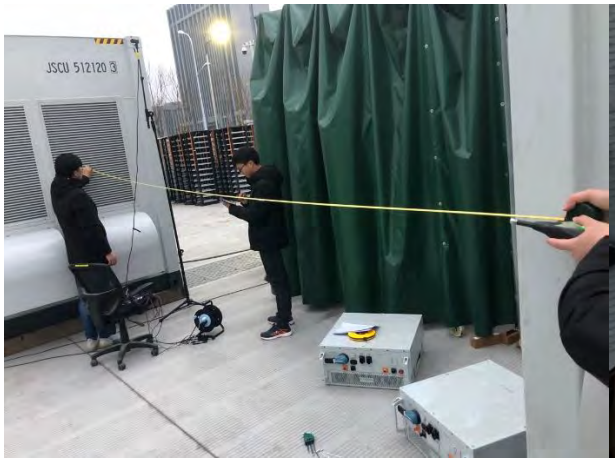

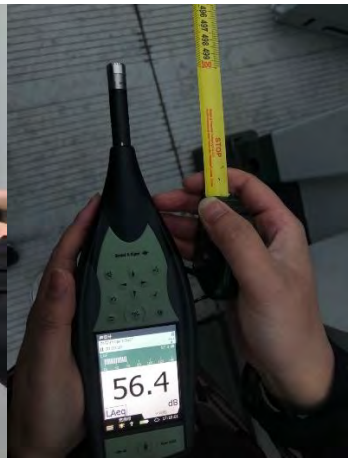

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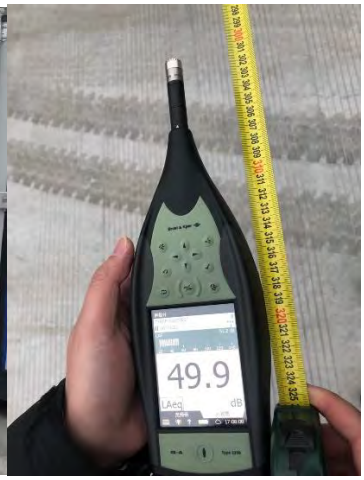

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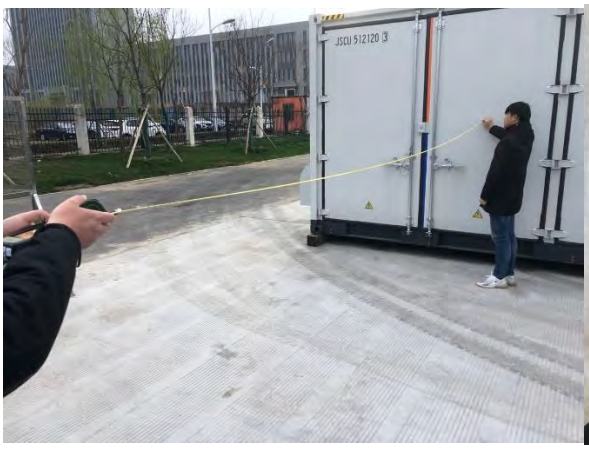

1m

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Exhibit F-FM-200 Material Safety Data Sheet

Material Safety Data Sheet

FM-200®

Version 2.1

Revision Date 07/11/2011 Ref. 130000036866

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	FM-200®
Tradename/Synonym	:	FE-227 2-Hydroperfluoropropane Propane, 1,1,1,2,3,3,3-Heptafluoro- HFC-227eaHP 2-Hydroheptafluoropropane Heptafluoropropane 2-H-heptafluoropropane 1,1,1,2,3,3,3-Heptafluoropropane R-227 R227 HFC-227ea
MSDS Number	:	130000036866
Product Use	:	Fire extinguishing agent
Manufacturer	:	DuPont 1007 Market Street Wilmington, DE 19898
Product Information	:	1-800-441-7515 (outside the U.S. 1-302-774-1000)
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Misuse or intentional inhalation abuse may lead to death without warning.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Rapid evaporation of the liquid may cause frostbite.

Potential Health Effects

Skin : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Eyes	:	Contact with liquid or refrigerated gas can cause cold burns and frostbite.
Inhalation	:	Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects. Other symptoms potentially related to misuse or inhalation abuse are: Anaesthetic effects, Light-headedness, dizziness, confusion, incoordination, drowsiness, or unconsciousness, irregular heartbeat with a strange sensation in the chest, heart thumping, apprehension, feeling of fainting, dizziness or weakness. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Carcinogenicity

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
1,1,1,2,3,3,3-Heptafluoropropane	431-89-0	100 %

SECTION 4. FIRST AID MEASURES

Skin contact	:	In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Take off all contaminated clothing immediately. Consult a physician. Wash contaminated clothing before re-use. Treat for frostbite if necessary by gently warming affected area.
Eye contact	:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician if necessary.
Inhalation	:	Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.

Ingestion	:	Is not considered a potential route of exposure.
General advice	:	Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.
Notes to physician	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5. FIREFIGHTING MEASURES

Fire and Explosion Hazard	:	The product is not flammable. Hazardous decomposition products : Hydrogen fluoride, Carbonyl fluoride
Suitable extinguishing media	:	This material is a fire extinguishing agent.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak - evacuate until gas has dispersed.
Spill Cleanup	:	Ventilate area using forced ventilation, especially low or enclosed places where heavy vapors might collect.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Do not breathe gas. Avoid contact with skin, eyes and clothing. Provide sufficient air exchange and/or exhaust in work rooms. For personal protection see section 8. Wash hands thoroughly after handling. Wash clothing after use. Decomposition will occur when product comes in contact with open flame or electrical heating elements. Handle in accordance with good industrial hygiene and safety practice.

Storage	:	Valve protection caps and valve cutlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Never attempt to lift cylinder by its cap. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Separate full containers from empty containers. Keep at temperature not exceeding 52°C. Do not store near combustible materials. Keep container tightly closed in a dry and well-ventilated place. Store in original container. Protect from contamination. Avoid area where salt or other corrosive materials are present.
Storage temperature	:	< 52 °C (< 126 °F)

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls	:	Use only with adequate ventilation. Keep container tightly closed.
Personal protective equipment		
Respiratory protection	:	Wear NIOSH approved respiratory protection as appropriate.
Hand protection	:	Additional protection: Impervious gloves
Eye protection	:	Safety glasses with side-shields Additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material.
Skin and body protection	:	Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.
Protective measures	:	Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines

Exposure Limit Values

1,1,1,2,3,3,3-Heptafluoropropane

AEL *	(DUPONT)	1,000 ppm	8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	Liquefied gas
Odor	:	none
Melting point/range	:	-131 °C (-204 °F)
Boiling point	:	-16.3 °C (2.7 °F)
Vapour Pressure	:	4,547 hPa at 25 °C (77 °F)
Density	:	1.388 g/cm3 at 25 °C (77 °F) (as liquid)

SECTION 10. STABILITY AND REACTIVITY

Stability	:	Stable at normal temperatures and storage conditions.
Incompatibility	:	Alkali metals Alkaline earth metals, Powdered metals, Powdered metal salts
Hazardous decomposition products	:	Hazardous decomposition products , Hydrogen fluoride , Carbonyl fluoride, Carbon monoxide, Carbon dioxide
Hazardous reactions	:	Polymerization will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

FM-200®

Inhalation 4 h LC50	:	> 788698 ppm , rat
Inhalation	:	dog Cardiac sensitization
Dermal	:	not applicable
Oral	:	not applicable
Skin irritation	:	No skin irritation, Not tested on animals

Not expected to cause skin irritation based on expert review of the properties of the substance.

Eye irritation	:	No eye irritation, Not tested on animals Not expected to cause eye irritation based on expert review of the properties of the substance.
Sensitisation	:	Does not cause skin sensitization., Not tested on animals Not expected to cause sensitization based on expert review of the properties of the substance.
		Did not cause sensitization on laboratory animals. There are no reports of human respiratory sensitization.
Repeated dose toxicity	:	Inhalation rat No toxicologically significant effects were found.
Carcinogenicity	:	Overall weight of evidence indicates that the substance is not carcinogenic.
Mutagenicity	:	Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Did not cause genetic damage in cultured bacterial cells.
Reproductive toxicity	:	Animal testing showed no reproductive toxicity. Information given is based on data obtained from similar substances.
Teratogenicity	:	Animal testing showed no developmental toxicity.
Further information	:	Cardiac sensitisation threshold limit : 730190 mg/m3

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity
FM-200®

96 h LC50	:	Danio rerio (zebra fish) > 200 mg/l Information given is based on data obtained from similar substances.
96 h LC50	:	Oncorhynchus mykiss (rainbow trout) > 81.8 mg/l

Information given is based on data obtained from similar substances.

72 h EC50	:	Pseudokirchneriella subcapitata > 114 mg/l Information given is based on data obtained from similar substances.
72 h EC50	:	Pseudokirchneriella subcapitata > 118 mg/l Information given is based on data obtained from similar substances.
48 h EC50	:	Daphnia magna (Water flea) > 200 mg/l Information given is based on data obtained from similar substances.
48 h EC50	:	Daphnia magna (Water flea) > 97.9 mg/l Information given is based on data obtained from similar substances.

Environmental Fate
FM-200®

Biodegradability aerobic	:	1 % OECD Test Guideline 301 Not readily biodegradable.
Biodegradability aerobic	:	5 % OECD Test Guideline 301 Not readily biodegradable.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal	:	Can be used after re-conditioning. Recover by distillation or remove to a permitted waste disposal facility. Comply with applicable Federal, State/Provincial and Local Regulations.
Environmental Hazards	:	Empty pressure vessels should be returned to the supplier.

SECTION 14. TRANSPORT INFORMATION

DOT	UN number	:	3296
	Proper shipping name	:	Heptafluoropropane
	Class	:	2.2
	Labelling No.	:	2.2
IATA_C	UN number	:	3296

	Proper shipping name	:	Heptafluoropropane
	Class	:	2.2
	Labelling No.	:	2.2
IMDG	UN number	:	3296
	Proper shipping name	:	Heptafluoropropane
	Class	:	2.2
	Labelling No.	:	2.2

SECTION 15. REGULATORY INFORMATION

SARA 313 Regulated Chemical(s)	:	SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
California Prop. 65	:	Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known

SECTION 16. OTHER INFORMATION

		HMIS
Health	:	1
Flammability	:	0
Reactivity/Physical hazard	:	0
PPE	:	Personal Protection rating to be supplied by user depending on use conditions.

FM-200 is a registered trademark of E. I. du Pont de Nemours and Company
Before use read DuPont's safety information.
For further information contact the local DuPont office or DuPont's nominated distributors.
® DuPont's registered trademark

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing,

storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.

Exhibit G-Samsung Battery Specifications

1. Product and Company Identification USA, EU

Important Note: As a solid, manufactured article, exposure to hazardous ingredients is not expected with normal use. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication Standard requirement. The information contained in this Material Safety Data Sheet contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Commercial product name
MODEL CM0940R0003A (94Ah capacity)

Use of the substance/preparation
Lithium-Ion battery

Company/undertaking identification

Manufacturer
SAMSUNG SDI Co. LTD
428-5 Gongse-dong, Giheung-gu, Yongin-si,
Gyeonggi-do, 446-577 Korea
Telephone: ++82 31 210 8535
Telefax: ++82 31 210 8289

Contact person: Euiryong Bang

Telephone:

Responsible Department: Development Team
Responsible for the safety data sheet: er.bang@samsung.com

Further Information
Battery-System: Lithium-Ion (Li-ion)
Voltage: 3.68V
Anode (negative electrode): based on intercalation graphite
Cathode (positive electrode): based on lithiated metal oxide (Cobalt, Nickel, Manganese)

Remark:

The information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. SAMSUNG SDI Co., Ltd. makes no warranty, expressed or implied, with respect to this information and disclaims all liabilities from reliance on it.

2. Hazards Identification USA

Route(s) of Entry
There is no hazard when the measures for handling and storage are followed.

Signs and Symptoms of Exposure
In case of cell damage, possible release of dangerous substances and a flammable gas mixture.

OSHA Hazard Communication: This material is not considered hazardous by the OSHA Hazard Communication Standard 29CFR 1910.1200.

Carcinogenicity (NTP): Not listed
Carcinogenicity (IARC): Not listed
Carcinogenicity (OSHA): Not listed

Special hazards for human health and environment
There is no hazard when the measures for handling and storage are followed.
In case of cell damage, possible release of dangerous substances and a flammable gas mixture.

2. Hazards Identification USA, EU

Explication of special hazards for human health and environment
Not classified as dangerous according to directive 1999/45/EEC
There is no hazard when the measures for handling and storage are followed.
In case of cell damage, possible release of dangerous substances and a flammable gas mixture.

3. Composition/information on ingredients USA, EU

Hazardous components

EC-No.	CAS-No.	Chemical name	Quantity	EU-Classification
215-154-6	1307-96-6	Cobalt oxide	< 30 %	Xn, N R22435053
215-202-6	1313-13-9	Manganese dioxide	< 30 %	Xn R20/22
215-215-7	1313-99-1	Nickel oxide	< 30 %	Carc. Cat. 1, T R49-43-48/23--53
231-153-3	7440-44-0	Carbon	10 - 30 %	
		Electrolyte (*)	10 - 20 %	Carc. Cat. 3, C, R10-34-40-43
	24937-79-9	Polyvinylidene fluoride (PVdF)	< 10 %	
231-072-3	7429-90-5	Aluminium foil	2 - 10 %	

231-159-6	7440-50-8	Copper foil	2 - 10 %	
		Aluminium and inert materials	5 - 10 %	

Full text of each relevant R phrase can be found in heading 16.

Further Information
For information purposes:
(*) Main ingredients: Lithium hexafluorophosphate, organic carbonates

Because of the cell structure the dangerous ingredients will not be available if used properly.
During charge process a lithium graphite intercalation phase is formed.

Mercury content: Hg < 0.1mg/kg

Cadmium content: Cd < 1mg/kg

Lead content: Pb: < 10mg/kg

4. First Aid Measures USA, EU

General information
The following first aid measures are required only in case of exposure to interior battery components after damage of the external battery casing.
Undamaged, closed cells do not represent a danger to the health.

After inhalation
Ensure of fresh air. Consult a physician.

After contact with skin
In case of contact with skin wash off immediately with plenty of water. Consult a physician.

After contact with eyes
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Seek medical treatment by eye specialist.

After ingestion
Drink plenty of water.
Call a physician immediately.

5. Fire Fighting Measures USA, EU

Suitable extinguishing media
Cold water and dry powder in large amount are applicable.
Use metal fire extinction powder or dry sand if only few cells are involved.

Special hazards arising from the chemical
May form hydrofluoric acid if electrolyte comes into contact with water.
In case of fire, the formation of the following flue gases cannot be excluded:
Hydrogen fluoride (HF), Carbon monoxide and carbon dioxide.

Protective equipment and precautions for firefighters
Wear self-contained breathing apparatus and protective suit.
Additional information
If possible, remove cell(s) from fire fighting area. If heated above 125°C, cell(s) can explode/vent. Cell is not flammable but internal organic material will burn if the cell is incinerated.

6. Accidental Release Measures USA, EU

Personal precautions
Use personal protective clothing.
Avoid contact with skin, eyes and clothing.
Avoid breathing fume and gas.

Environmental precautions
Do not discharge into the drains/surface waters/groundwater.
Methods for cleaning up/taking up
Take up mechanically and send for disposal.

7. Handling and Storage USA, EU

Handling

Advice on safe handling
Avoid short circuiting the cell. Avoid mechanical damage of the cell. Do not open or disassemble.
Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition.

Storage

Requirements for storage rooms and vessels
Storage at room temperature (approx. 20°C) at approx. 20-50% of the nominal capacity
(OCV approx. 3.5-3.7 V).
Keep in closed original container.

8. Exposure Controls/Personal Protection Exposure limit values Exposure limits USA

8. Exposure controls/personal protection Exposure limit values Exposure limits (EH40) EU

CAS-No.	Chemical name	ml/m³	mg/m³	F/ml	Category	Origin
7440-44-0	Graphite, respirable	 -	4 -		TWA (8 h) STEL (15 min)	WEL WEL

Additional advice on limit values
During normal charging and discharging there is no release of product.

Occupational exposure controls
No specific precautions necessary.

Protective and hygiene measures
When using do not eat, drink or smoke. Wash hands before breaks and after work.

Respiratory protection
No specific precautions necessary.

Hand protection
No specific precautions necessary.

Eye protection
No specific precautions necessary.

Skin protection
No specific precautions necessary.

.

9. Physical and Chemical Properties USA, EU

Appearance

Form:	Solid
Color:	Various
Odor:	Odorless

Important health, safety and environmental information

Test method	
pHValue:	n.a.
Flash point:	n.a
Lower explosion limits:	n.a.
Vapour pressure:	n.a.
Density:	n.a.
Water solubility:	Insoluble
Ignition temperature:	n.a.

10. Stability and Reactivity USA, EU

Stability
Stable

Conditions to avoid
Keep away from open flames, hot surfaces and sources of ignition. Do not puncture, crush or incinerate.

Materials to avoid
No materials to be especially mentioned.

Hazardous decomposition products
In case of open cells, there is the possibility of hydrofluoric acid and carbon monoxide release.

Possibility of Hazardous Reactions
Will not occur

Additional information
No decomposition if stored and applied as directed.

11. Toxicological Information USA, EU

Empirical data on effects on humans
If appropriately handled and if in accordance with the general hygienic rules, no damages to health have become known.

12. Ecological Information USA, EU

Further information
Ecological injuries are not known or expected under normal use. Do not flush into surface water or sanitary sewer system.

13. Disposal Considerations USA, EU

Advice on disposal
For recycling consult manufacturer.

Contaminated packaging
Disposal in accordance with local regulations.

14. Transport Information USA, EU

US DOT 49 CFR 172.101

Proper shipping name
Lithium-ion batteries

ID Number:	UN3480
Hazard Class or Division:	9
Packing group:	II
Label:	9

Land transport (ADR/RID)

UN number:	3480
ADR/RID class:	9
Classification code:	M4
Warning plate	
Hazard label:	9

ADR/RID packing group:	II
Limited quantity:	LQ 0
Tunnel restriction code:	E
Description of the goods	Lithium-ion batteries

Other applicable information (land)
LQ 0: No exemption under the conditions of 3.4.2.
Transport category: 2

Marine transport

UN number:	3480
IMDG code:	9
Marine pollutant:	No
Hazard label:	9

IMDG packing group:	II
EmS:	F-A, S-I
Limited quantity:	None
Description of the goods	Lithium-ion batteries

Air transport

UN/ID number:	3480
ICAO/IATA-DGR:	9
Hazard label:	9

ICAO packing group:	II
Limited quantity Passenger:	-
IATA-packing instructions - Passenger:	965

IATA-max. quantity - Passenger:	5 kg G
IATA-packing instructions - Cargo:	965
IATA-max. quantity - Cargo:	35 kg G
Description of the goods	Lithium-ion batteries

Other applicable information

Lithium equivalent:	29.6g
Wh-rating per cell:	346 Wh

15. Regulatory Information USA

U.S. Regulations

National Inventory TSCA
SAMSUNG SDI certifies that all chemical components of the Model CS0600R0005B (60 Ah capacity) Lithium-Ion Battery are listed on the US EPA TSCA 8(b) Inventory or are exempt from listing.

SARA
To the best of our knowledge this product contains no toxic chemicals subject to the supplier notification requirements of Section 313 of the Superfund Amendments and Reauthorization Act (SARA/EPCRA) and the requirements of 40 CFR Part 372.

15. Regulatory information EU

Labeling

Hazardous components which must be listed on the label
As an article the product does not need to be labeled in accordance with EC directives or respective national laws.

EU regulatory information
1999/13/EC (VOC): 0 %

16. Other Information USA

Hazardous Materials Information Label (HMIS)
Health: 0
Flammability: 0
Physical Hazard: 0

NFPA Hazard Ratings
Health: 0
Flammability: 0
Reactivity: 0
Unique Hazard:

16. Other Information EU

Full text of R-phrases referred to under sections 2 and 3
R10 Flammable.

R20/22	Harmful by inhalation and if swallowed.
R22	Harmful if swallowed.
R34	Causes burns.
R40	Limited evidence of a carcinogenic effect.
R43	May cause sensitization by skin contact.
R48/23	Toxic: danger of serious damage to health by prolonged exposure through inhalation.
R49	May cause cancer by inhalation.
R50	Very toxic to aquatic organisms.
R53	May cause long-term adverse effects in the aquatic environment.

Further Information USA, EU

Data of sections 4 to 8, as well as 10 to 12, do not necessarily refer to the use and the regular handling of the product (in this sense consult package leaflet and expert information), but to release of major amounts in case of accidents and irregularities. The information describes exclusively the safety requirements for the product
(s) and is based on the present level of our knowledge. This data does not constitute a guarantee for the characteristics of the product(s) as defined by the legal warranty regulations. "(n.a. = not applicable; n.d. = not determined)"

The data for the hazardous ingredients were taken respectively from the last version of the sub-contractor's safety data sheet.

Exhibit H-Power Electronics Solar Inverter (HEC1500V) Information

HEC V1500

UTILITY SCALE SOLAR INVERTER

The Power Electronics HEC V1500 are reliable 1500Vdc outdoor utility-scale inverters, with more than 2.5GW already installed worldwide. The HEC V1500 inverter family has 25 different models ranging from 1MW to 3.5MW, and it is available for the IEC and UL market.

With up to seven 500kW power modules connected in parallel, the HEC V1500 is a multi-level 1500Vdc system built on the Power Electronics expertise in >1,000Vdc systems and in the proven Freesun HEC modular topology.

The HEC V1500 power stage is based on a multi-level IGBT topology, which makes the difference in the 1500Vdc technology. Power Electronics takes advantage of the three-level topology, reducing the power stage losses, and increasing the inverter efficiency.

THE MOST RELIABLE 1500VDC UTILITY-SCALE PV INVERTER IN THE MARKET

NEXT GENERATION

1500 VDC

EXTENDED MPPT
MPPt

AUTOMATIC REDUNDANT POWER MODULE SYSTEM
ARPMS

iCOOL V

ADJUSTABLE POWER
DAY
NIGHT

OUTDOOR DURABILITY

INGRESS PROTECTION

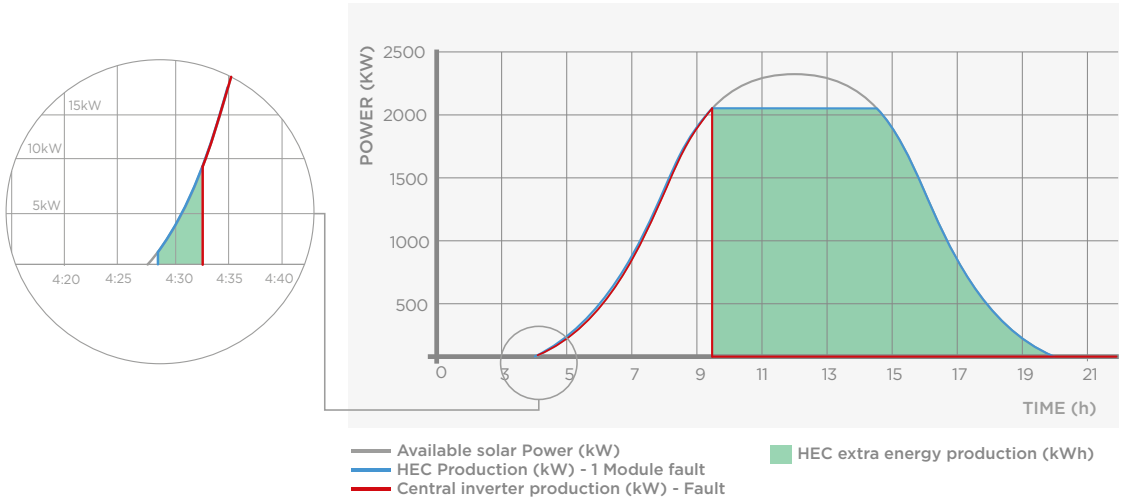
ACTIVE HEATING

3 LEVEL TOPOLOGY

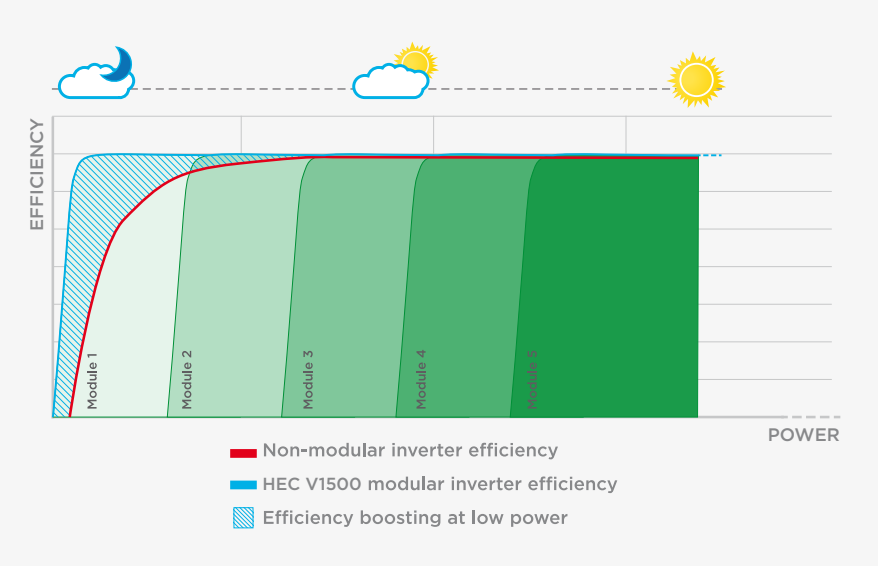
AUTOMATIC REDUNDANT POWER MODULE SYSTEM (ARPMS)

The HEC V1500 topology combines the advantages of a central inverter with the availability of string inverters. HEC V1500 is a modular central inverter based on an Automatic Redundant Power Module (350kVA to 500kVA per stage).

If there is a fault in one power module, it is taken off-line and its output power is distributed evenly among the remaining functioning modules. All power modules work in parallel controlled by a dual redundant main control. As the main governor of the system it is responsible for the MPPt tracking, synchronization sequence and overall protection. The automatic redundant capability based on our industrial systems is able to shift the main control in the event of a fault, restoring the backup control and restarting the station to guarantee high availability. (patent pending)



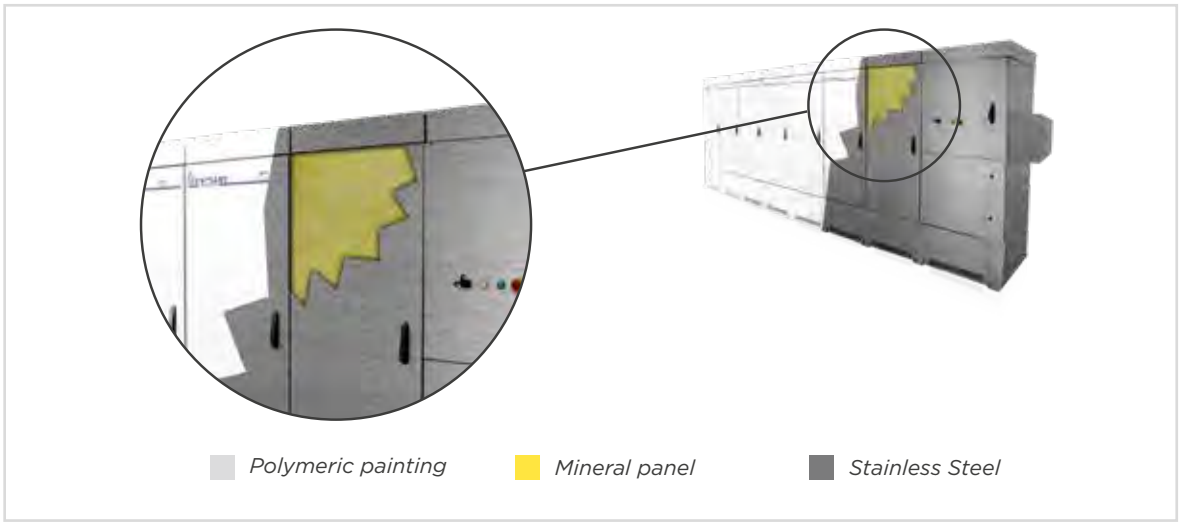
A modular inverter is more efficient than a standard central inverter. During low radiation conditions, a modular architecture uses the correct number of power modules to provide power, while a central inverter must consume power internally to support the entire system. With lower losses, a modular inverter can provide power earlier in the morning and stop later at the end of the day. As a result, throughout the entire service life of the PV plant, the HEC V1500 inverter generates higher yields than a standard central inverter with a higher reliability than string inverters.



ROBUST DESIGN

HEC V1500 inverters have been designed to last for more than 25 years of operation in harsh environments and extreme weather conditions. HEC V1500 units are tested and ready to withstand conditions from the frozen siberian tundra to the californian Death Valley, featuring:

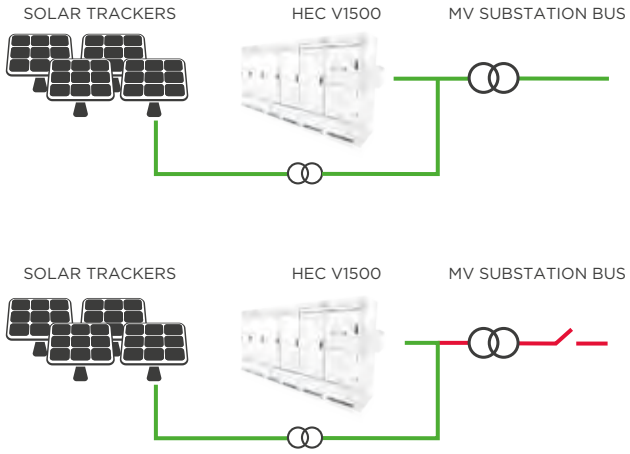
- Totally sealed cabin for protecting electronics against dust and moisture.
- Conformal coating on electronic boards shields PCBs from harsh atmospheres.
- Temperature and humidity controlled active heating prevents internal water condensation.
- Stainless Steel construction with 2mm thickness for maximum enclosure longevity.
- The HEC V1500 has a C5-M degree of protection according to ISO 12944.
- 50mm mineral panel isolates the cabinet from solar heat gains.
- Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages. The solid HEC V1500 structure avoids the need of additional external structures.
- Random units selected to pass a Factory Water Tightness Test ensuring product quality.



BACK FEED TRACKER SUPPLY

During solar power plant normal operation, the solar trackers are powered by the grid via the auxiliary service transformer. In case of a loss of mains, a UPS with battery systems is needed for powering the solar trackers and ensures achieving the safety position.

Battery systems increase the CAPEX and the OPEX of the project, due to a high maintenance requirement, extra energy consumption and battery replacement. In order to avoid these disadvantages, HEC V1500 inverter is able to provide the safety power supply required without using battery systems, taking profit of the energy available in the PV field, and therefore offering the most cost-effective solution in the market.

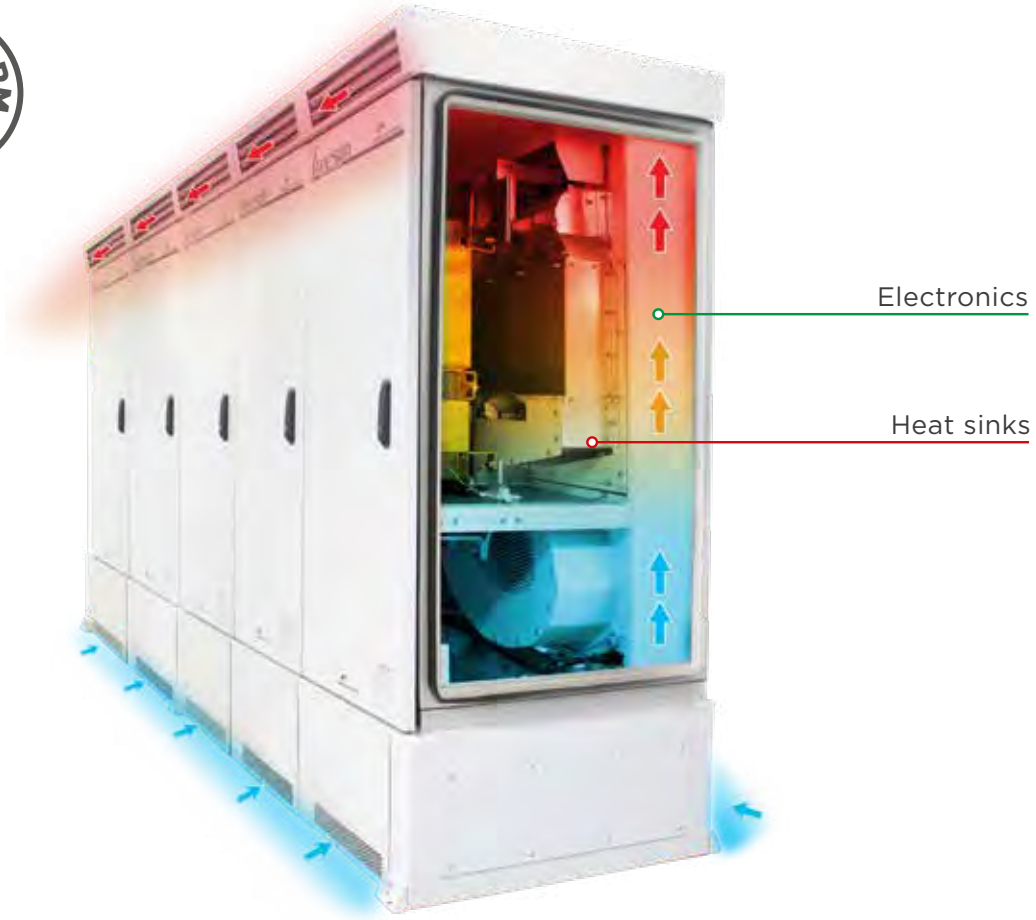


REVOLUTIONARY COOLING SYSTEM

The Power Electronics HEC V1500 series includes the innovative and sophisticated iCOOL V performance that allows HEC V1500 to work up to 50°C at nominal power. The cooling system iCOOL V smartly cools the inverter, regulating the cooling system capacity depending on the data from the temperature sensors.

HEC V1500 modules are divided into two main areas: clean area (electronics) and hot area (heat sink). The electronics are totally sealed and use a temperature control low flow cooling system that reduces filters clogging and maintenance intervals. The hot area integrates a speed controlled fan for each module, simplifying the cooling system and reducing the maintenance tasks.

Furthermore, due to the modular topology, the iCOOL V reduces the Stand-by consumption at low capacity to the maximum, boosting the cooling capacity for photovoltaic installations situated up to 4000 meters above sea level. (patent pending)



VAR AT NIGHT

At night, the HEC V1500 inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

EASY TO MONITOR

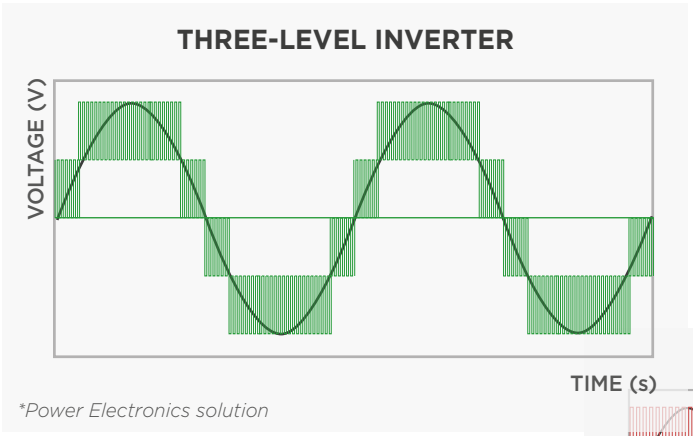
The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors. The app user friendly interface allows quick and easy access to critical information (energy registers, production and events).

ACTIVE HEATING

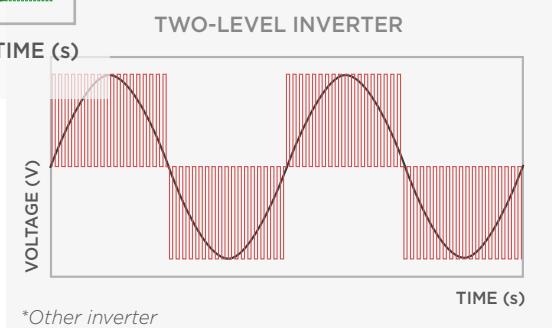
At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors. This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. (patented)

MULTILEVEL TOPOLOGY

The multilevel IGBT topology makes the difference in the 1500Vdc technology, being the most efficient way to manage high DC link voltages. Based in our long IGBT experience components used in the HEC PLUS series, the HEC V1500 takes profit of the three level IGBT topology reducing the power stage losses, increasing the efficiency and offering a very low total harmonic distortion.



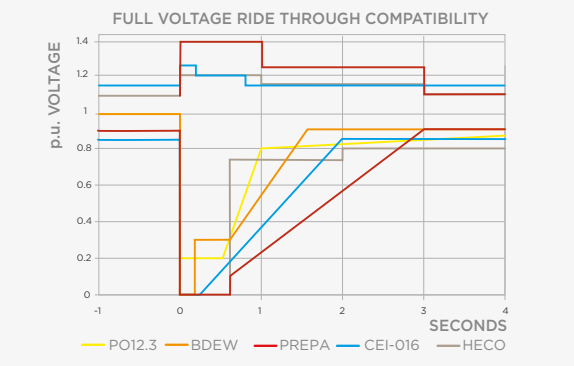
*Power Electronics solution



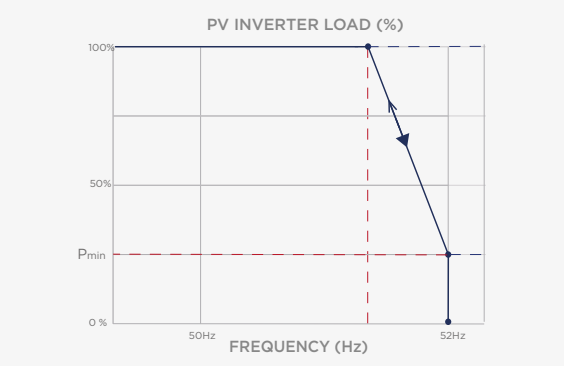
*Other inverter

DYNAMIC GRID SUPPORT

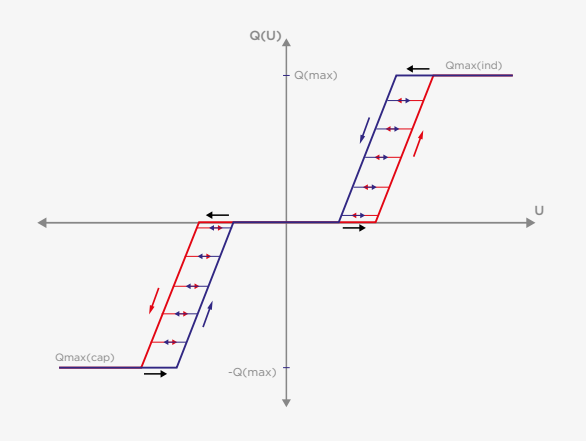
HEC V1500 firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment...), and can be configured to meet specific utility requirements.

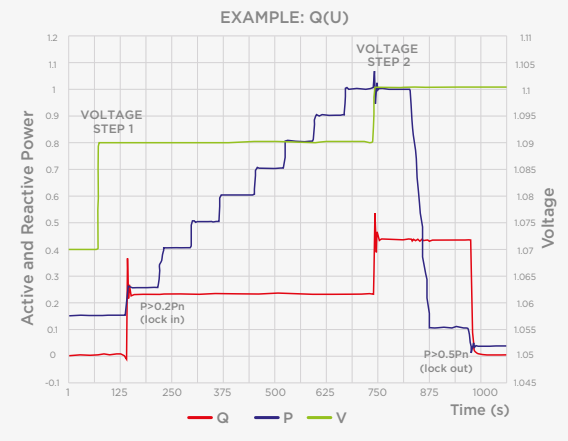


▲ **LVRT or ZVRT (Low Voltage Ride Through).** Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.



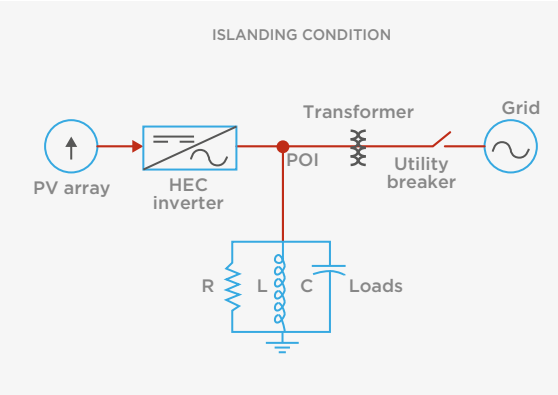
▲ **FRS (Frequency Regulation System).** Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.





▲ **Q(V) curve:** It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.

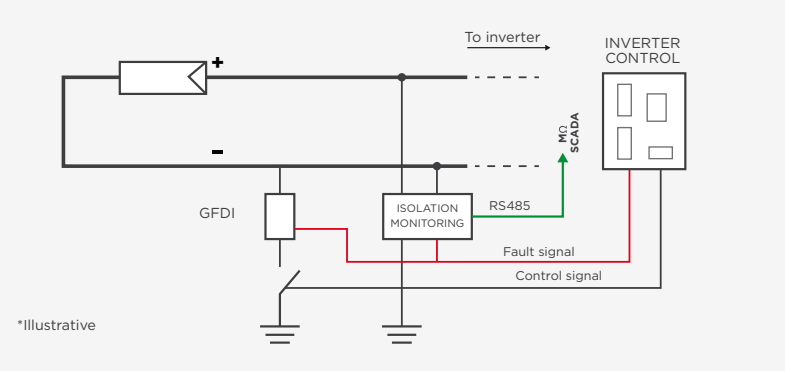
▲ **FRT (Frequency Ride Through):** Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



▲ **Anti-islanding:** This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

PV ARRAY TRANSFER KIT

By mounting this kit, the inverter and the PV plant will be able to shift its running conditions from negative grounded array to floating array and viceversa. Under regular conditions the inverter will be running with a negative pole grounded and therefore, a GDFI will provide protection against unlikely ground fault defects and the solar cells will not suffer a negative voltage relative to their surroundings at any time. This running mode can be transfered to a floating array configuration enabling an isolation monitoring device that the O&M can use for: regular PV plant isolation control, identification of the array affected by a ground fault defect and most important, increase the operator safety under O&M service activities.



DC DISCONNECTION & PROTECTION

HEC V1500 is available with an external DC disconnection and protection unit (DU unit) that will be coupled together with the inverter by a mounting kit. The DC subsystems are fully customizable and can be featured with up to 32 inputs.

The disconnecting unit goes one step further by improving the PV plant safety and operation for those who apply the best engineering.

EXTENDED MPPT

Using the latest modulation techniques, inspired by the most accurate and powerful motor control applications, has lead to the widest MPPt full power window in the solar market. It allows optimal PV plant design and boosted performance rates.

EASY TO SERVICE

By providing full front and rear access the HEC series simplifies the maintenance tasks improving the MTTR (achieving a lower OPEX). The frontal access allows the checking of the whole electronic cabinet (electronics boards, semiconductors, power supply, contactors...) while the rear access permits the revision of AC fuses and LCL filter.

HEC-US V1500 690VAC

TECHNICAL CHARACTERISTICS

NORTH AMERICA

		690VAC - MPPt Window 976V-1310V				
		FRAME 3	FRAME 4	FRAME 5	FRAME 6	FRAME 7
NUMBER OF MODULES		3	4	5	6	7
REFERENCE		FS1275CU15	FS1700CU15	FS2125CU15	FS2550CU15	FS3000CU15
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1275	1700	2125	2550	3000
	AC Output Power(kVA/kW) @25°C [1]	1530	2040	2550	3060	3500
	AC Output Power(kW) @50°C; PF=0.9	1150	1530	1910	2250	2700
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	690V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading ... 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	976V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1100V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η)	98.5%	98.7%	98.7%	98.7%	98.7%
	CEC (η)	98.0%	98.5%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRON-MENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTI-FICA-TIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

HEC-US V1500 645VAC

TECHNICAL CHARACTERISTICS

NORTH AMERICA

		645VAC - MPPt Window 913V-1310V				
		FRAME 3	FRAME 4	FRAME 5	FRAME 6	FRAME 7
NUMBER OF MODULES		3	4	5	6	7
REFERENCE		FS1200CU15	FS1600CU15	FS2000CU15	FS2400CU15	FS2800CU15
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1200	1600	2000	2400	2800
	AC Output Power(kVA/kW) @25°C [1]	1430	1910	2390	2860	3345
	AC Output Power(kW) @50°C; PF=0.9	1080	1440	1800	2160	2520
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	645V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading ... 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	913V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1075V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η)	98.4%	98.5%	98.6%	98.6%	98.6%
	CEC (η)	98.0%	98.0%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRON-MENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App display				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTI-FICA-TIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

HEC-US V1500 630VAC

TECHNICAL CHARACTERISTICS

NORTH AMERICA

		630VAC - MPPt Window 891V-1310V				
		FRAME 3	FRAME 4	FRAME 5	FRAME 6	FRAME 7
NUMBER OF MODULES		3	4	5	6	7
REFERENCE		FS1270CU15	FS1695CU15	FS2120CU15	FS2540CU15	FS3001CU15
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1180	1570	1965	2360	2750
	AC Output Power(kVA/kW) @40°C [1]	1270	1695	2120	2540	3000
	AC Output Power(kVA/kW) @25°C [1]	1400	1870	2340	2800	3275
	Max. AC Output Current (A) @50°C	1080	1440	1800	2160	2520
	Max. AC Output Current (A) @40°C	1165	1550	1940	2330	2715
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	630V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading ... 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC)	@50°C 891V-1310V / @40°C 891V-1285V / @25°C 891V-1250V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1050V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η) Preliminary	98.5%				
	CEC (η) Preliminary	98.5%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRON-MENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Power derating >40°C/104°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Compatible with third party SCADA controls				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTI-FICA-TIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

HEC-US V1500 600VAC

TECHNICAL CHARACTERISTICS

NORTH AMERICA

		600VAC - MPPt Window 849V-1310V				
		FRAME 3	FRAME 4	FRAME 5	FRAME 6	FRAME 7
NUMBER OF MODULES		3	4	5	6	7
REFERENCE		FS1100CU15	FS1475CU15	FS1850CU15	FS2225CU15	FS2600CU15
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1100	1475	1850	2225	2600
	AC Output Power(kVA/kW) @25°C [1]	1335	1780	2225	2660	3110
	AC Output Power(kW) @50°C; PF=0.9	990	1325	1665	2000	2340
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	600V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading ... 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	849V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1050V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η)	98.4%	98.5%	98.6%	98.6%	98.6%
	CEC (η)	98.0%	98.0%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRON-MENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTI-FICA-TIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

NOTES [1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

HEC-US V1500 565VAC

TECHNICAL CHARACTERISTICS

NORTH AMERICA

		565VAC - MPPt Window 800V-1310V				
		FRAME 3	FRAME 4	FRAME 5	FRAME 6	FRAME 7
NUMBER OF MODULES		3	4	5	6	7
REFERENCE		FS1050CU15	FS1400CU15	FS1750CU15	FS2100CU15	FS2450CU15
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1050	1400	1750	2100	2450
	AC Output Power(kVA/kW) @25°C [1]	1250	1675	2090	2510	2930
	AC Output Power(kW) @50°C; PF=0.9	945	1260	1575	1890	2205
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	565V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading ... 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	800V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1050V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η)	98.2%	98.4%	98.5%	98.5%	98.5%
	CEC (η)	98.0%	98.0%	98.0%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRON-MENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTI-FICA-TIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

NOTES
[1] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

Exhibit I-Power Electronics Solar Inverter (HEMK600V) Information

POWER ELECTRONICS

PURE ENERGY

SOLAR SOLUTIONS

INVERTERS | STATIONS

PURE ENERGY

Pure Energy is our motivation for leading the renewable energy generation, it is the search for product and service perfection, it is our vision of a world, clean and sustainable for our children and future generations.

CONTENTS


CAUTION
PRÉCAUTION

Since 1987 Power Electronics Industrial division has been producing high power variable speed drives and soft starters for low and medium voltage AC motor applications. This experience has allowed Power Electronics to position itself as the leading manufacturer of utility scale solar inverters thanks to our unique product features, patented designs, fastest global delivery times and unbeatable 24/7 Power on Support. Power Electronics fully designs and manufactures its Freesun inverters in Valencia, Spain and is proud to have some of the most advanced R&D laboratories and factories in the industry.

30 YEARS OF PRODUCT EXCELLENCE

24/7 POWER ON SUPPORT

INTERNATIONAL PRESENCE

FINANCIAL STABILITY AND STRENGTH

INDEPENDENT REPORTS AND CERTIFICATIONS

SUSTAINABLE GROWTH

ENGINEERING & CONSULTING

Energy projects often require customer specific solutions, for this reason our clients also have our Engineering and Consulting department at their disposal, which is comprised of a wide number of highly skilled and experienced engineers that are available to modify our standard product to suit customer demands and ensure our clients get the product they need.

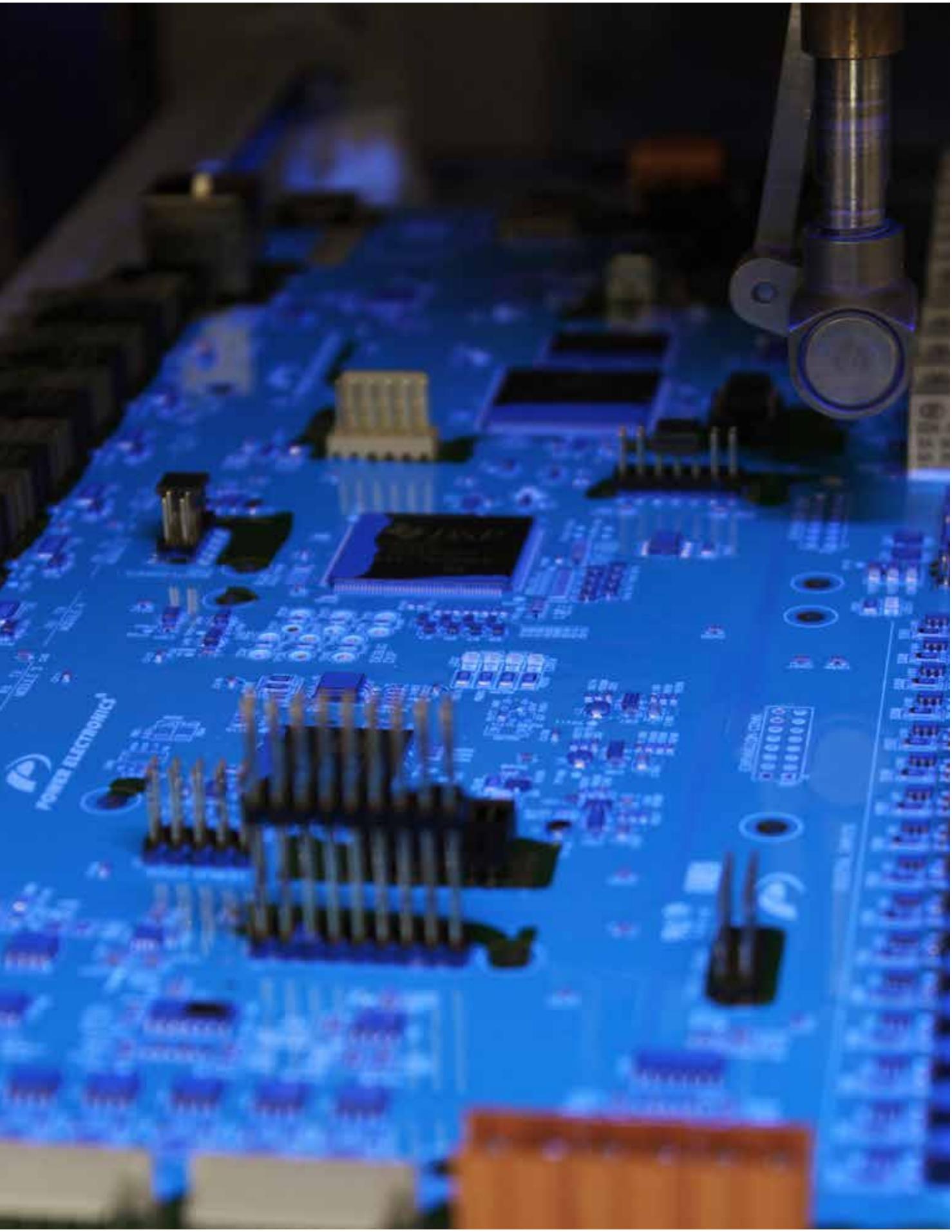
TECHNICAL ADVICE
ENGINEERING
CUSTOMIZED SOLUTIONS
PROJECT MANAGEMENT
COMMISSIONING
24/7 SERVICE

VERTICAL INTEGRATION

Flexibility and specialization play a key role in the manufacture of standard products, but even more so in personalized products. We design and manufacture integrally the mechanics of our equipment. Vertical integration gives us the flexibility to adapt to customer requirements and still provide very short delivery times.

INNOVATION & DESIGN FLEXIBILITY
HIGH QUALITY COMPONENTS
RELIABLE ENGINEERING
FACTORY TESTED
VALUE CHAIN SUPERVISION
IMMEDIATE DELIVERY

"We design, manufacture and test the electronic boards of all our products"



AVAILABILITY

COMMISSIONING

CUSTOMER SUPPORT

ONSITE ASSISTANCE

SPARE PARTS WARRANTY

TRAINING SEMINARS

WARRANTY

POWER ON SUPPORT

Power on Support is the concept of a customer oriented strategy implemented by Power Electronics since its origins more than 30 years ago with 24/7 after sales service available for all our customers and end users without the need of signing an O&M contract.

Customer Oriented Strategy.

WORLDWIDE PRESENCE

From the beginning, customer service and internationalization have been key elements for the development of the company. Thanks to the global expansion in the five continents, today we have presence and provide technical service throughout the world.

● HEADQUARTERS

+20
DELEGATIONS

+100
SALES COUNTRIES

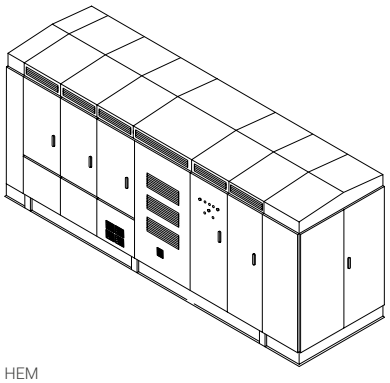
+12GW
SOLAR INVERTERS INSTALLED

+12GW
ANNUAL CAPACITY PRODUCTION

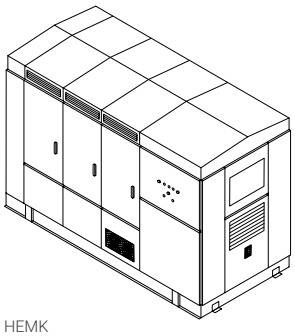

UNITED KINGDOM
POLAND
GERMANY
FRANCE
ITALY
SPAIN
PORTUGAL
TURKEY
MOROCCO
CHINA
JAPAN
S. KOREA
DUBAI
INDIA
SINGAPORE
SOUTH AFRICA
AUSTRALIA
NEW ZEALAND

PRODUCT RANGE

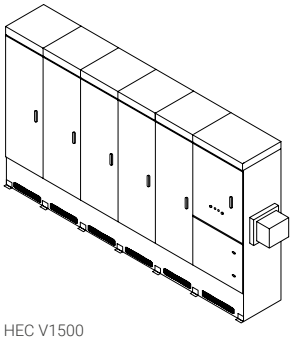
SOLAR INVERTERS



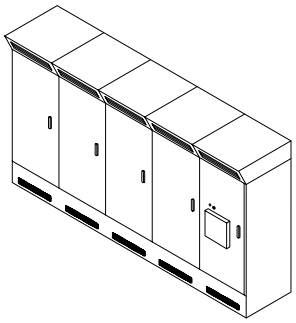
HEM
3000 kVA - 3630 kVA
34.5V
1500 Vdc
P. 15



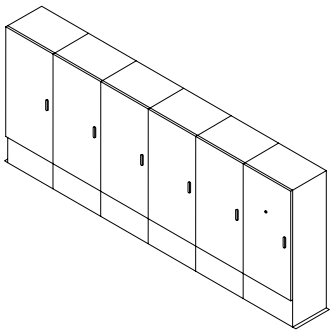
HEMK
2000 kVA - 3800 kVA
600 Vac - 690 Vac
1500 Vdc
P. 29



HEC V1500
1050 kVA - 3500 kVA
565 Vac - 690 Vac
P. 43

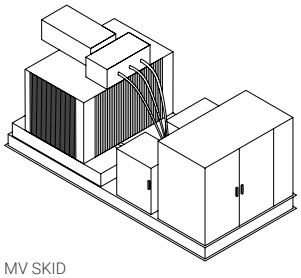


HEC PLUS
1000 kVA - 2550 kVA
400 Vac - 460 Vac
1000 Vdc
P. 65

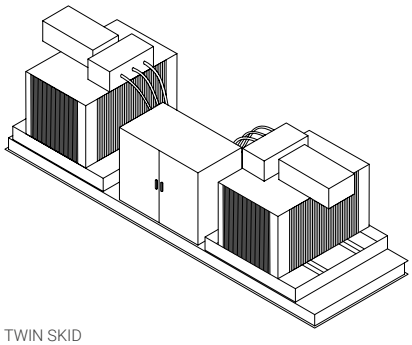


HE PLUS
1000 kVA - 2550 kVA
400 Vac - 460 Vac
1000 Vdc
P. 85

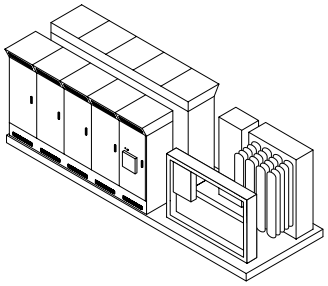
SOLAR STATIONS



MV SKID
1050 kVA - 3800 kVA
12 kV - 36 kVac
Oil Transformer
2L+P/V Switchgear
P. 99

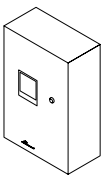


TWIN SKID
3000 kVA - 7600 kVA
12 kV - 36 kVac
Oil Transformer
2L+ 2P/2V Switchgear
P. 103

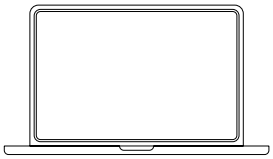


HEK
1000 kVA - 7000 kVA
12.47 kV - 34.5 kV
1000 Vdc - 1500 Vdc
Open Skid Station
P. 107

CONTROL AND MONITORING SOLUTIONS



FREESUN PPC
P. 113



FREESUN PORTAL
P. 117

FREESUN APP
P. 119

SOLAR INVERTERS

UTILITY SCALE
OUTDOOR AND INDOOR INVERTERS

HEM Solar inverter

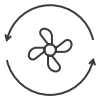
HEM

UTILITY SCALE MV CENTRAL STRING INVERTER

FIELD REPLACEABLE UNITS

OUTDOOR DURABILITY

IP65 AVAILABLE



ICOOL 3

ACTIVE HEATING

3 LEVEL TOPOLOGY

ECON MODE

MULTI MPPT AVAILABLE

THE INNOVATIVE MEDIUM VOLTAGE CENTRAL STRING INVERTER

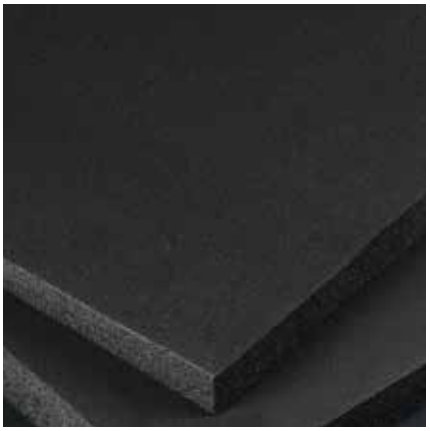
The Power Electronics HEM medium voltage inverter is designed for utility scale solar applications, that require the advantages of a central inverter solution but also the modularity of a string architecture. The HEM can reach up to a nominal power of 3.6MVA, and offers a wide MPPT window. It also has the added advantage of having an integrated medium voltage transformer and switchgear.

Its architecture, composed of six field replaceable units (FRU), is designed to provide the highest availability and optimize yield production. Its use in Utility Scale PV plants provides considerable savings in CAPEX, since having an integrated MV transformer and switchgear reduces the need of additional connections between the LV and MV sides.

Thanks to the Power Electronics iCOOL3 cooling system, the HEM is the first inverter able to provide IP65 degree of protection with an air cooling system, and as a result reducing OPEX costs.

ROBUST DESIGN

Polymeric Painting



Closed-Cell Insulation

Galvanized Steel | Stainless Steel (Optional)

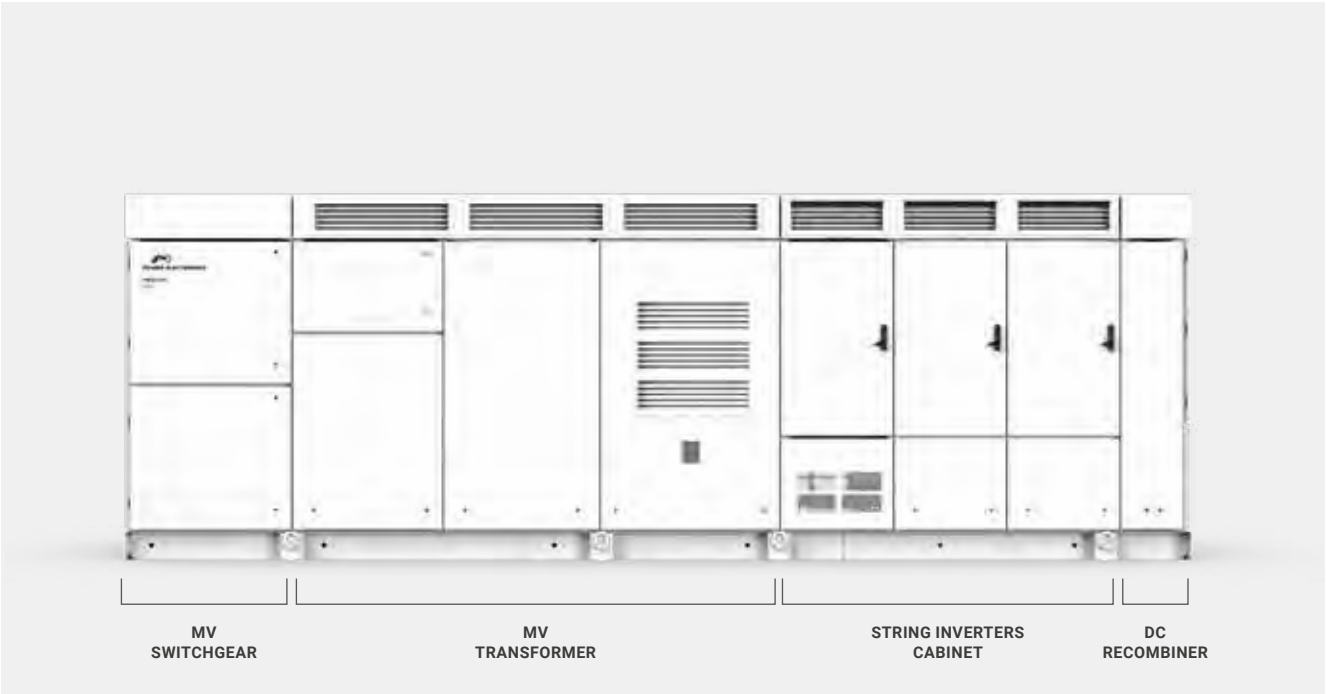
HEM inverter modules have a design life of greater than 30 years of operation in harsh environments and extreme weather conditions. HEM units are tested and ready to withstand conditions from the frozen Siberian tundra to the Californian Death Valley, featuring:

Totally sealed electronics cabinet protects electronics against dust and moisture.
Conformal coating on electronic boards shields PCBs from harsh atmospheres.
Temperature and humidity controlled active heating prevents internal water condensation.
C4 degree of protection according to ISO 12944. Up to C5-M optional.
Closed-Cell insulation panel isolates the cabinet from solar heat gains.
Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages.
The solid HEM structure avoids the need of additional external structures.
Random units selected to pass a Factory Water Tightness Test ensuring product quality.
IP65 Available.

REAL TURN-KEY SOLUTION - EASY TO SERVICE

With the HEM, Power Electronics offers a real turn-key solution, including the MV transformer and switchgear fully assembled and tested at the factory. The HEM is a compact turn-key solution that will reduce site design, installation and connection costs.

By providing full front access the HEM series simplifies the maintenance tasks, reducing the MTTR (and achieving a lower OPEX). The total access allows a fast swap of the FRUs without the need of qualified technical personnel.



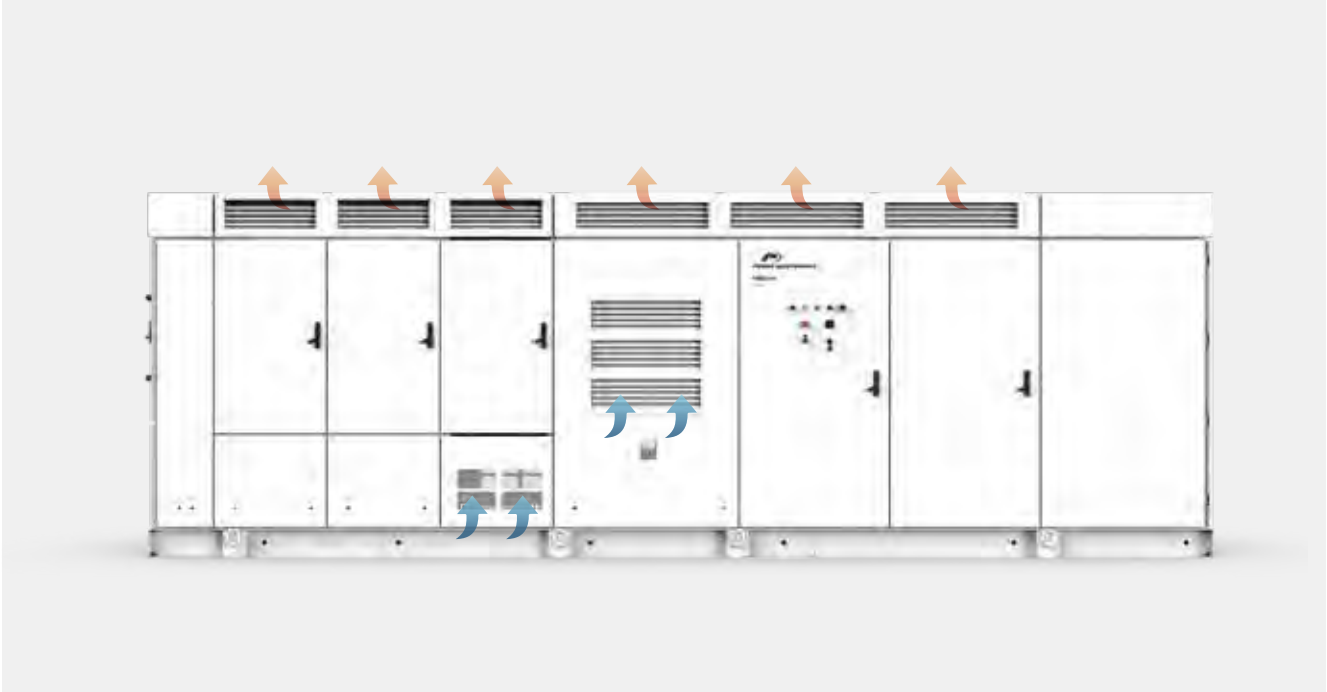
STRING CONCEPT POWER STAGES

The HEM combines the advantages of a central inverter with the modularity of the string inverters. Its power stages are designed to be easily replaceable on the field without the need of advanced technical service personnel, providing a safe, reliable and fast Plug&Play assembly system.

Following the modular philosophy of the Freesun series, the HEM is composed of 6 FRUs (field replaceable units), being able to work with up to 6 different MPPts, providing a perfect solution for irregular locations, where each area of the PV plant has a different production curve. HEM is also available with a single MPPt, where all the power stages are physically joined in the DC side and therefore, in the event of a fault, the faulty module is taken off-line and its power is distributed evenly among the remaining functioning FRUs.

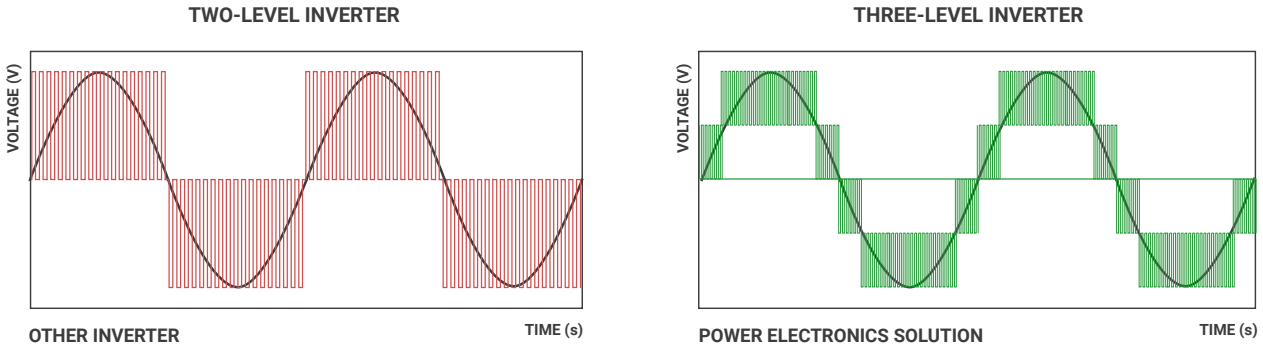
INNOVATIVE COOLING SYSTEM

Based on more than 3 years of experience with our MV Variable Speed Drive, the iCOOL3 is the first air-cooling system allowing IP65 degree of protection in an outdoor solar inverter. iCOOL3 delivers a constant stream of clean air to the FRUs and the MV transformer, being the most effective way of reaching up to IP65 degree of protection, without having to maintain cumbersome dust filters or having to use liquid-cooling systems, avoiding the commonly known inconveniences of it (complex maintenance, risk of leaks, higher number of components…), therefore resulting in an OPEX cost reduction.



MULTILEVEL TOPOLOGY

The multilevel IGBT topology is the most efficient approach to manage high DC link voltages and makes the difference in the 1,500 Vdc design. Power Electronics has many years of power design in both inverters and MV drives and the HEMK design is the result of our experience with 3 level topologies. The 3 level IGBT topology reduces stage losses, increases inverter efficiency and minimizes total harmonic distortion.



VAR AT NIGHT

At night, the HEM inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

ACTIVE HEATING

At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing maintenance. **PATENTED**

ECON MODE

This innovative control mode allows increasing the efficiency of the MV transformer up to 25%, reducing the power consumption of the plant and therefore providing considerable savings. Available as an optional kit, this feature has a payback time of less than a few years, therefore resulting in the increase of the plant lifetime overall revenue.

EASY TO MONITOR

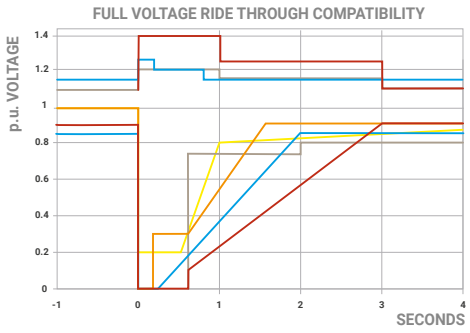
The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors.

The app user-friendly interface allows quick and easy access to critical information (energy registers, production and events).

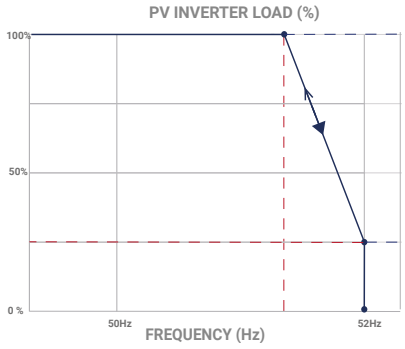
AVAILABLE INFORMATION	Grid and PV field data. Inverter and Power module data (Voltages, currents, power, temperatures, I/O status...). Weather conditions. Alarms and warnings events. Energy registers. Others.
FEATURES	Easy Wireless connection. Comprehensive interface. Real time data. Save and copy settings.
LANGUAGE	English, Spanish.
SYSTEM REQUIREMENTS	iOS or Android devices.
SETTINGS CONTROL	Yes

DYNAMIC GRID SUPPORT

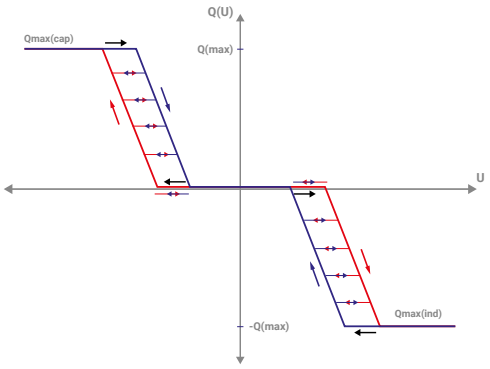
HEM firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment…), and can be configured to meet specific utility requirements.

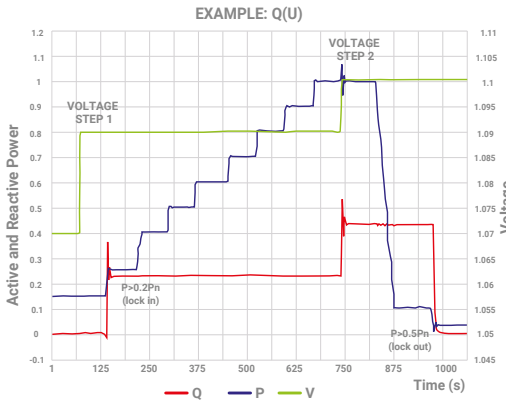


Low Voltage Ride Through (LVRT or ZVRT). Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive current, as long as the protection limits are not exceeded.

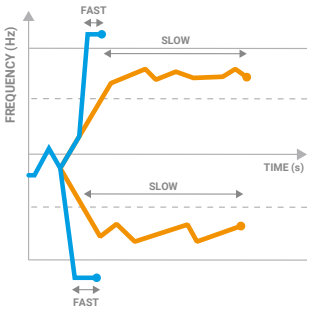


Frequency Regulation System (FRS). Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

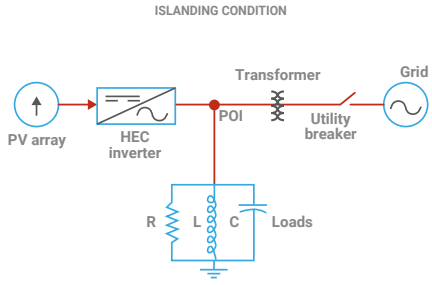




Q(V) curve. It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



Frequency Ride Through (FRT). Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



Anti-islanding. This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

FRONT VIEW

BACK VIEW

TECHNICAL CHARACTERISTICS HEM

REFERENCE		FS3300M
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	3300
	AC Output Power(kVA/kW) @25°C [1]	3630
	Operating Grid Voltage(VAC) [2]	34.5kV ±10%
	Operating Grid Frequency(Hz)	50Hz/60Hz
	Current Harmonic Distortion (THDi)	< 3% per IEEE519
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night
INPUT	MPPt @full power (VDC)	934V-1310V
	Maximum DC voltage	1500V
	Number of inputs [2]	Up to 36
	Max. DC continuous current (A)	3970
	Max. DC short circuit current (A)	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98% including MV transformer (preliminary)
	Max. Power Consumption (KVA)	20
CABINET	Dimensions [WxDxH] (ft)	21.7 x 7 x 7
	Dimensions [WxDxH] (m)	6.6 x 2.2 x 2.2
	Type of ventilation	Forced air cooling
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating
	Relative Humidity	4% to 100% non condensing
	Max. Altitude (above sea level) [4]	2000m
	Noise level [5]	< 79 dBA
CONTROL INTERFACE	Interface	Graphic Display
	Communication protocol	Modbus TCP
	Plant Controller Communication	Optional
	Keyed ON/OFF switch	Standard
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device
	General AC Protection	MV Switchgear (configurable)
	General DC Protection	Fuses
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2
	Compliance	NEC 2014 / NEC 2017 (optional)
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003.

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[4] Consult Power Electronics for other altitudes.
[5] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEM

REFERENCE		FS3225M
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	3225
	AC Output Power(kVA/kW) @25°C [1]	3550
	Operating Grid Voltage(VAC) [2]	34.5kV ±10%
	Operating Grid Frequency(Hz)	50Hz/60Hz
	Current Harmonic Distortion (THDi)	< 3% per IEEE519
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night
INPUT	MPPt @full power (VDC)	913V-1310V
	Maximum DC voltage	1500V
	Number of inputs [2]	Up to 36
	Max. DC continuous current (A)	3970
	Max. DC short circuit current (A)	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98% including MV transformer (preliminary)
	Max. Power Consumption (KVA)	20
CABINET	Dimensions [WxDxH] (ft)	21.7 x 7 x 7
	Dimensions [WxDxH] (m)	6.6 x 2.2 x 2.2
	Type of ventilation	Forced air cooling
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating
	Relative Humidity	4% to 100% non condensing
	Max. Altitude (above sea level) [4]	2000m
	Noise level [5]	< 79 dBA
CONTROL INTERFACE	Interface	Graphic Display
	Communication protocol	Modbus TCP
	Plant Controller Communication	Optional
	Keyed ON/OFF switch	Standard
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device
	General AC Protection	MV Switchgear (configurable)
	General DC Protection	Fuses
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2
	Compliance	NEC 2014 / NEC 2017 (optional)
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003.

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[4] Consult Power Electronics for other altitudes.
[5] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEM

REFERENCE		FS3150M
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	3150
	AC Output Power(kVA/kW) @25°C [1]	3465
	Operating Grid Voltage(VAC) [2]	34.5kV ±10%
	Operating Grid Frequency(Hz)	50Hz/60Hz
	Current Harmonic Distortion (THDi)	< 3% per IEEE519
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night
INPUT	MPPt @full power (VDC)	891V-1310V
	Maximum DC voltage	1500V
	Number of inputs [2]	Up to 36
	Max. DC continuous current (A)	3970
	Max. DC short circuit current (A)	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98% including MV transformer (preliminary)
	Max. Power Consumption (KVA)	20
CABINET	Dimensions [WxDxH] (ft)	21.7 x 7 x 7
	Dimensions [WxDxH] (m)	6.6 x 2.2 x 2.2
	Type of ventilation	Forced air cooling
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating
	Relative Humidity	4% to 100% non condensing
	Max. Altitude (above sea level) [4]	2000m
	Noise level [5]	< 79 dBA
CONTROL INTERFACE	Interface	Graphic Display
	Communication protocol	Modbus TCP
	Plant Controller Communication	Optional
	Keyed ON/OFF switch	Standard
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device
	General AC Protection	MV Switchgear (configurable)
	General DC Protection	Fuses
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2
	Compliance	NEC 2014 / NEC 2017 (optional)
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003.

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[4] Consult Power Electronics for other altitudes.
[5] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEM

REFERENCE		FS3075M
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	3075
	AC Output Power(kVA/kW) @25°C [1]	3380
	Operating Grid Voltage(VAC) [2]	34.5kV ±10%
	Operating Grid Frequency(Hz)	50Hz/60Hz
	Current Harmonic Distortion (THDi)	< 3% per IEEE519
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night
INPUT	MPPt @full power (VDC)	870V-1310V
	Maximum DC voltage	1500V
	Number of inputs [2]	Up to 36
	Max. DC continuous current (A)	3970
	Max. DC short circuit current (A)	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98% including MV transformer (preliminary)
	Max. Power Consumption (KVA)	20
CABINET	Dimensions [WxDxH] (ft)	21.7 x 7 x 7
	Dimensions [WxDxH] (m)	6.6 x 2.2 x 2.2
	Type of ventilation	Forced air cooling
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating
	Relative Humidity	4% to 100% non condensing
	Max. Altitude (above sea level) [4]	2000m
	Noise level [5]	< 79 dBA
CONTROL INTERFACE	Interface	Graphic Display
	Communication protocol	Modbus TCP
	Plant Controller Communication	Optional
	Keyed ON/OFF switch	Standard
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device
	General AC Protection	MV Switchgear (configurable)
	General DC Protection	Fuses
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2
	Compliance	NEC 2014 / NEC 2017 (optional)
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003.

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[4] Consult Power Electronics for other altitudes.
[5] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEM

REFERENCE		FS3000M
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	3000
	AC Output Power(kVA/kW) @25°C [1]	3300
	Operating Grid Voltage(VAC) [2]	34.5kV ±10%
	Operating Grid Frequency(Hz)	50Hz/60Hz
	Current Harmonic Distortion (THDi)	< 3% per IEEE519
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night
INPUT	MPPt @full power (VDC)	849V-1310V
	Maximum DC voltage	1500V
	Number of inputs [2]	Up to 36
	Max. DC continuous current (A)	3970
	Max. DC short circuit current (A)	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98% including MV transformer (preliminary)
	Max. Power Consumption (KVA)	20
CABINET	Dimensions [WxDxH] (ft)	21.7 x 7 x 7
	Dimensions [WxDxH] (m)	6.6 x 2.2 x 2.2
	Type of ventilation	Forced air cooling
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating
	Relative Humidity	4% to 100% non condensing
	Max. Altitude (above sea level) [4]	2000m
	Noise level [5]	< 79 dBA
CONTROL INTERFACE	Interface	Graphic Display
	Communication protocol	Modbus TCP
	Plant Controller Communication	Optional
	Keyed ON/OFF switch	Standard
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device
	General AC Protection	MV Switchgear (configurable)
	General DC Protection	Fuses
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2
	Compliance	NEC 2014 / NEC 2017 (optional)
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003.

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[4] Consult Power Electronics for other altitudes.
[5] Readings taken 1 meter from the back of the unit.

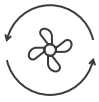
HEMK

UTILITY SCALE CENTRAL STRING INVERTER

FIELD REPLACEABLE UNITS

OUTDOOR DURABILITY

IP65 AVAILABLE



ICOOL 3

ACTIVE HEATING

3 LEVEL TOPOLOGY

MULTI MPPT AVAILABLE

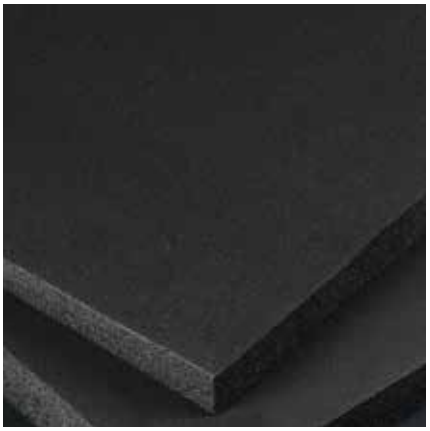
COMBINING THE BENEFITS OF CENTRAL AND STRING INVERTERS

The HEMK is the second generation 1500V inverter, based on the more than proven HEC V1500. This modular solar inverter offers the advantages of both central and string inverters. Reaching a very high power density, and an output power of 3.8MW, it is available in 6 different AC voltages, providing the flexibility to choose the best solution for each PV plant. The power stage architecture, composed of six field replaceable units (FRU), is designed to provide the highest availability and optimize yield production.

The innovative iCOOL3 cooling system allows the HEMK to be installed in the harshest environments, thanks to a degree of protection of up to IP65. This advanced air-cooling system, reduces the OPEX cost compared to other cooling solutions, that need the use of complex liquid-cooling systems.

ROBUST DESIGN

Polymeric Painting



Closed-Cell Insulation

Galvanized Steel | Stainless Steel (Optional)

HEMK inverter modules have a design life of greater than 30 years of operation in harsh environments and extreme weather conditions. HEMK units are tested and ready to withstand conditions from the frozen Siberian tundra to the Californian Death Valley, featuring:

Totally sealed electronics cabinet protects electronics against dust and moisture.
Conformal coating on electronic boards shields PCBs from harsh atmospheres.
Temperature and humidity controlled active heating prevents internal water condensation.
C4 degree of protection according to ISO 12944. Up to C5-M optional.
Closed-Cell insulation panel isolates the cabinet from solar heat gains.
Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages.
The solid HEMK structure avoids the need of additional external structures.
Random units selected to pass a Factory Water Tightness Test ensuring product quality.
IP65 available.

COMPACT DESIGN - EASY TO SERVICE

By providing full front access the HEMK series simplifies the maintenance tasks, reducing the MTTR (and achieving a lower OPEX). The total access allows a fast swap of the FRUs without the need of qualified technical personnel.

With the HEMK, Power Electronics offers its most compact solution, achieving 3.8MW in just 12ft long, reducing installation costs and labor time.

STRING CONCEPT POWER STAGES

The HEMK combines the advantages of a central inverter with the modularity of the string inverters. Its power stages are designed to be easily replaceable on the field without the need of advanced technical service personnel, providing a safe, reliable and fast Plug&Play assembly system.

Following the modular philosophy of the Freesun series, the HEMK is composed of 6 FRUs (field replaceable units), being able to work with up to 6 different MPPTs, providing a perfect solution for irregular locations, where each area of the PV plant has a different production curve.

HEMK is also available with a single MPPt, where all the power stages are physically joined in the DC side and therefore, in the event of a fault, the faulty module is taken off-line and its power is distributed evenly among the remaining functioning FRUs.

INNOVATIVE COOLING SYSTEM

Based on more than 3 years of experience with our MV Variable Speed Drive, the iCOOL3 is the first air-cooling system allowing IP65 degree of protection in an outdoor solar inverter. iCOOL3 delivers a constant stream of clean air to the FRUs, being the most effective way of reaching up to IP65 degree of protection, without having to maintain cumbersome dust filters or having to use liquid-cooling systems, avoiding the commonly known inconveniences of it (complex maintenance, risk of leaks, higher number of components…), therefore resulting in an OPEX cost reduction.

VAR AT NIGHT

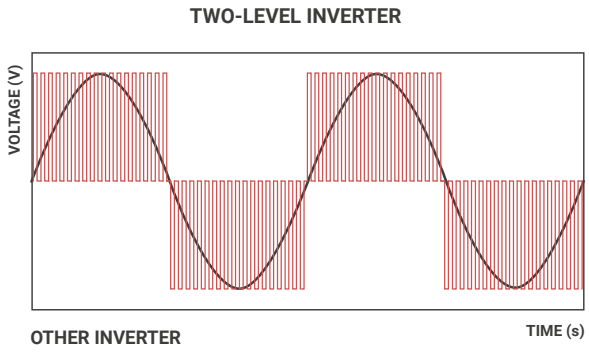
At night, the HEMK inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

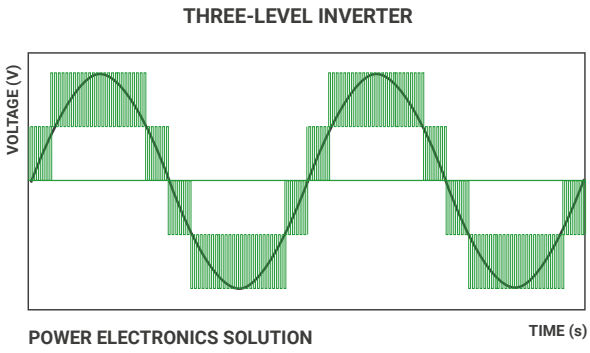
ACTIVE HEATING

At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors. This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PATENTED**

MULTILEVEL TOPOLOGY

The multilevel IGBT topology is the most efficient approach to manage high DC link voltages and makes the difference in the 1,500 Vdc design. Power Electronics has many years of power design in both inverters and MV drives and the HEMK design is the result of our experience with 3 level topologies. The 3 level IGBT topology reduces stage losses, increases inverter efficiency and minimizes total harmonic distortion.





EASY TO MONITOR

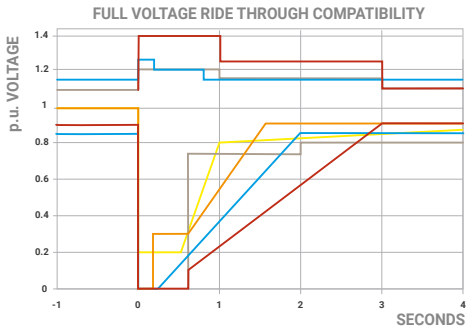
The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors.

The app user friendly interface allows quick and easy access to critical information (energy registers, production and events).

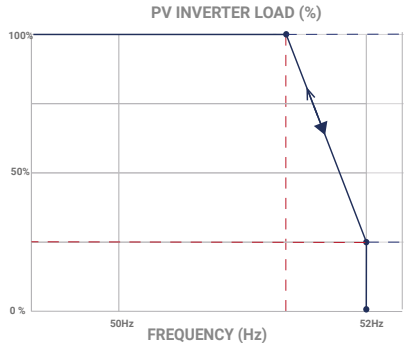
AVAILABLE INFORMATION	Grid and PV field data. Inverter and Power module data (Voltages, currents, power, temperatures, I/O status...). Weather conditions. Alarms and warnings events. Energy registers. Others.
FEATURES	Easy Wireless connection. Comprehensive interface. Real time data. Save and copy settings.
LANGUAGE	English, Spanish.
SYSTEM REQUIREMENTS	iOS or Android devices.
SETTINGS CONTROL	Yes

DYNAMIC GRID SUPPORT

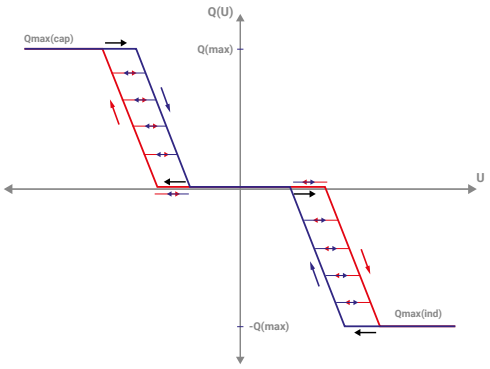
HEMK firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment…), and can be configured to meet specific utility requirements.

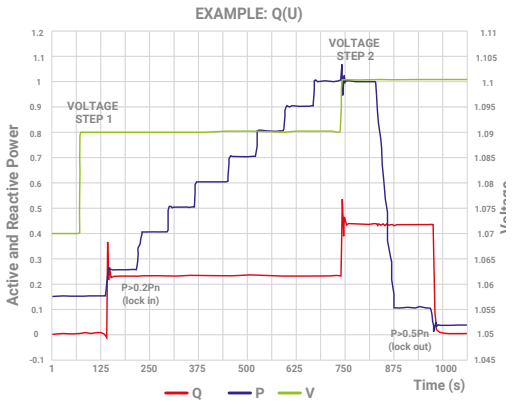


Low Voltage Ride Through (LVRT or ZVRT). Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive current, as long as the protection limits are not exceeded.

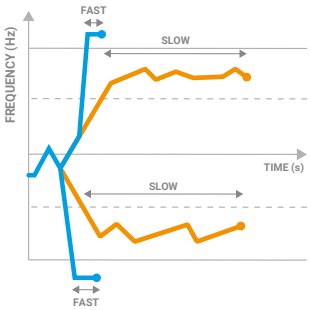


Frequency Regulation System (FRS). Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

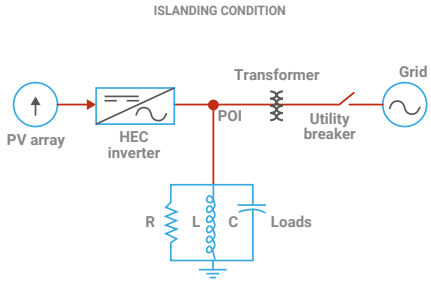




Q(V) curve. It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



Frequency Ride Through (FRT). Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



Anti-islanding. This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

TECHNICAL CHARACTERISTICS HEMK 690V

		FRAME 1	FRAME 2
REFERENCE		**FS2300K**	**FS3450K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2300	3450
	AC Output Power(kVA/kW) @25°C [1]	2530	3800
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	690V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	976V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.9	98.9
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12.3 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEMK 660V

		FRAME 1	FRAME 2
REFERENCE		**FS2200K**	**FS3300K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2200	3300
	AC Output Power(kVA/kW) @25°C [1]	2420	3630
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	660V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	934V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.8%	98.9%
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEMK 645V

		FRAME 1	FRAME 2
REFERENCE		**FS2150K**	**FS3225K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2150	3225
	AC Output Power(kVA/kW) @25°C [1]	2365	3550
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	645V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	913V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.8%	98.9%
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEMK 630V

		FRAME 1	FRAME 2
REFERENCE		**FS2100K**	**FS3150K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2100	3150
	AC Output Power(kVA/kW) @25°C [1]	2310	3465
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	630V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	891V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.8%	98.8%
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEMK 615V

		FRAME 1	FRAME 2
REFERENCE		**FS2050K**	**FS3075K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2050	3075
	AC Output Power(kVA/kW) @25°C [1]	2225	3380
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	615V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	870V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.8%	98.8%
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEMK 600V

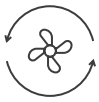
		FRAME 1	FRAME 2
REFERENCE		**FS2000K**	**FS3000K**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	2000	3000
	AC Output Power(kVA/kW) @25°C [1]	2200	3300
	Max. AC Output Current (A) @25°C	2120	3175
	Operating Grid Voltage(VAC) [2]	600V ±10%	
	Operating Grid Frequency(Hz)	50Hz/60Hz	
	Current Harmonic Distortion (THDi)	< 3% per IEEE519	
	Power Factor (cosine phi) [3]	0.5 leading … 0.5 lagging adjustable / Reactive Power injection at night	
INPUT	MPPt @full power (VDC)	849V-1310V	
	Maximum DC voltage	1500V	
	Number of inputs [2]	Up to 36	
	Number of MPPts	Up to 4	Up to 6
	Max. DC continuous current (A)	2645	3970
	Max. DC short circuit current (A)	4000	6000
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.8%	98.8%
	Max. Power Consumption (KVA)	8	10
CABINET	Dimensions [WxDxH] (ft)	9 x 7 x 7	12 x 7 x 7
	Dimensions [WxDxH] (m)	2.7 x 2.2 x 2.2	3.7 x 2.2 x 2.2
	Type of ventilation	Forced air cooling	
ENVIRONMENT	Degree of protection	NEMA3R - IP54 / IP65 available	
	Permissible Ambient Temperature	-35°C to +60°C / >50°C Active Power derating	
	Relative Humidity	4% to 100% non condensing	
	Max. Altitude (above sea level)	2000m; >2000m power derating (Max. 4000m)	
	Noise level [4]	< 79 dBA	
CONTROL INTERFACE	Interface	Graphic Display	
	Communication protocol	Modbus TCP	
	Plant Controller Communication	Optional	
	Keyed ON/OFF switch	Standard	
PROTECTIONS	Ground Fault Protection	GFDI and Isolation monitoring device	
	General AC Protection	Circuit Breaker	
	General DC Protection	Fuses	
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2	
CERTIFICATIONS	Safety	UL1741, CSA 22.2 No.107.1-01, UL62109-1, IEC62109-1, IEC62109-2	
	Compliance	NEC 2014 / NEC 2017 (optional)	
	Utility interconnect	UL 1741SA-Sept.2016, IEEE 1547-2003	

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult Power Electronics for other configurations.
[3] Consult P-Q charts available: Q(kVAr)=√(S(kVA)2-P(kW)2).
[4] Readings taken 1 meter from the back of the unit.

HEC V1500

UTILITY SCALE SOLAR INVERTER

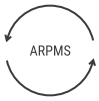
OUTDOOR DURABILITY



ICOOL V

ACTIVE HEATING

3 LEVEL TOPOLOGY



AUTOMATIC REDUNDANT POWER MODULE SYSTEM

THE MOST RELIABLE 1500VDC UTILITY-SCALE PV INVERTER IN THE MARKET

The Power Electronics HEC V1500 are reliable 1500Vdc outdoor utility-scale inverters, with more than 4GW already installed worldwide. The HEC V1500 inverter family has 25 different models ranging from 1MW to 3.5MW, and it is available for the IEC and UL market. With up to seven 500kW power modules connected in parallel, the HEC V1500 is a multilevel 1500Vdc system built on the Power Electronics expertise in >1,000Vdc systems and in the proven Freesun HEC modular topology.The HEC V1500 power stage is based on a multi-level IGBT topology, which makes the difference in the 1500Vdc technology. Power Electronics takes advantage of the three-level topology, reducing the power stage losses, and increasing the inverter efficiency

ROBUST DESIGN

Polymeric Painting

Mineral Panel

Galvanized Steel | Stainless Steel (Optional)

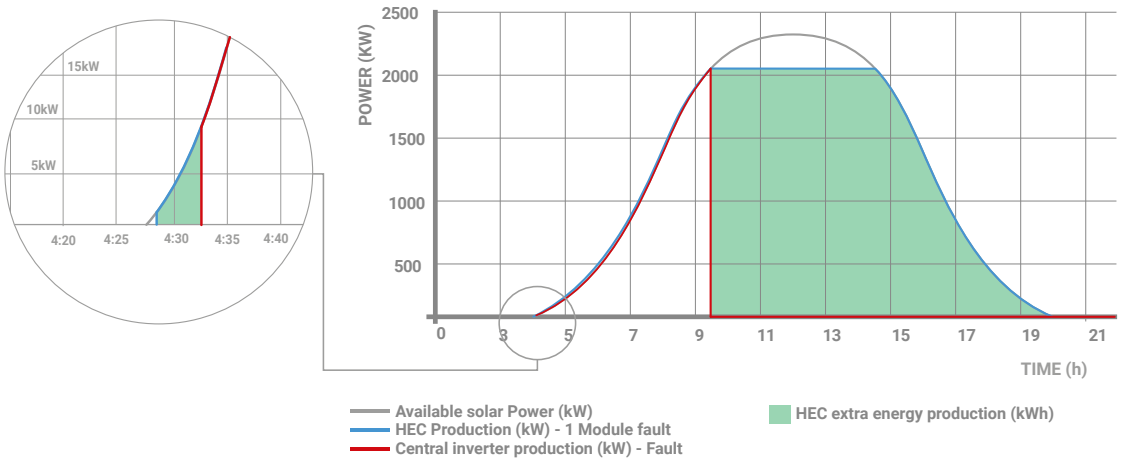
HEC V1500 inverters have been designed to last for more than 25 years of operation in harsh environments and extreme weather conditions. HEC V1500 units are tested and ready to withstand conditions from the frozen siberian tundra to the californian Death Valley, featuring:

- Totally sealed electronics cabinet protects electronics against dust and moisture.
- Conformal coating on electronic boards shields PCBs from harsh atmospheres.
- Temperature and humidity controlled active heating prevents internal water condensation.
- Galvanized Steel construction with 2mm thickness for maximum enclosure longevity.
- 50mm mineral panel isolates the cabinet from solar heat gains.
- Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages.
- The solid HEC V1500 structure avoids the need of additional external structures.
- Random units selected to pass a Factory Water Tightness Test ensuring product quality.
- C5-M degree of protection according to ISO 12944.

AUTOMATIC REDUNDANT POWER MODULE SYSTEM

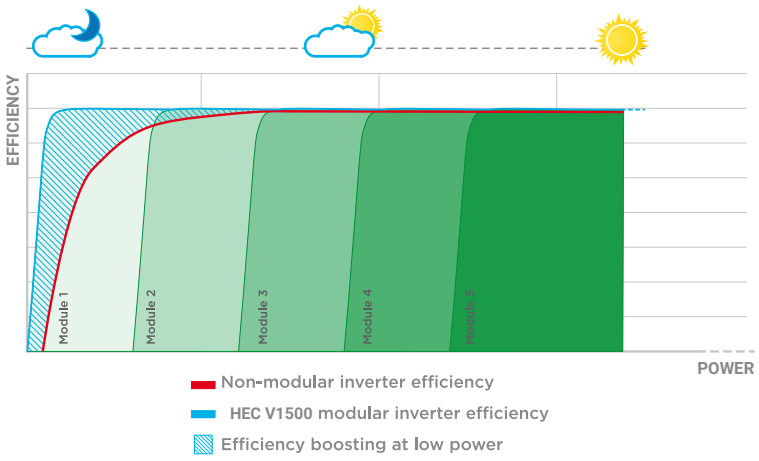
The HEC V1500 topology combines the advantages of a central inverter with the availability of string inverters. HEC V1500 is a modular central inverter based on an Automatic Redundant Power Module (350kVA to 500kVA per stage).

If there is a fault in one power module, it is taken off-line and its power is distributed evenly among the remaining functioning modules. All power modules work in parallel controlled by a dual redundant main control. As the main governor of the system it is responsible for the MPPt tracking, synchronization sequence and overall protection. The automatic redundant capability based on our industrial systems is able to shift the main control in the event of a fault, restoring the backup control and restarting the station to guarantee high availability. **PATENT PENDING**



A modular inverter is more efficient than a standard central inverter. During low radiation conditions, a modular architecture uses the correct number of power modules to provide power, while a central inverter must consume power internally to support the entire system.

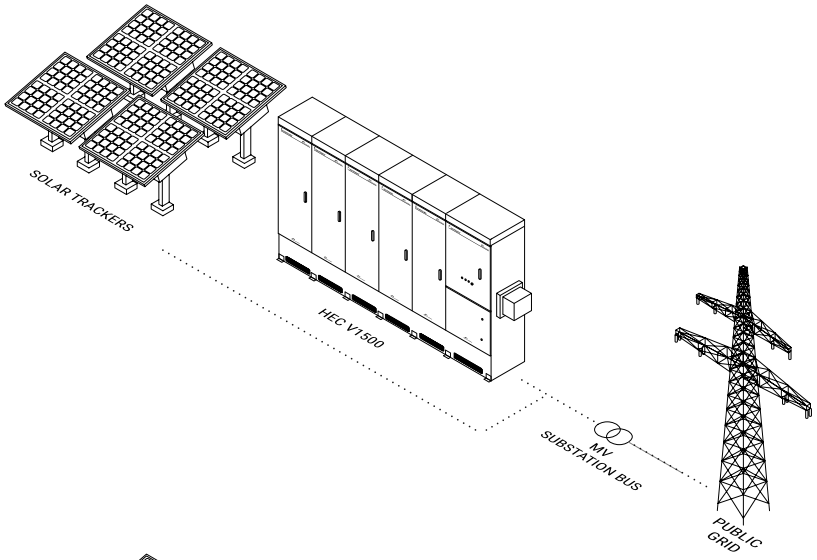
With lower losses, a modular inverter can provide power earlier in the morning and stop later at the end of the day. As a result, throughout the entire service life of the PV plant, the HEC V1500 inverter generates higher yields than a standard central inverter with a higher reliability than string inverters.



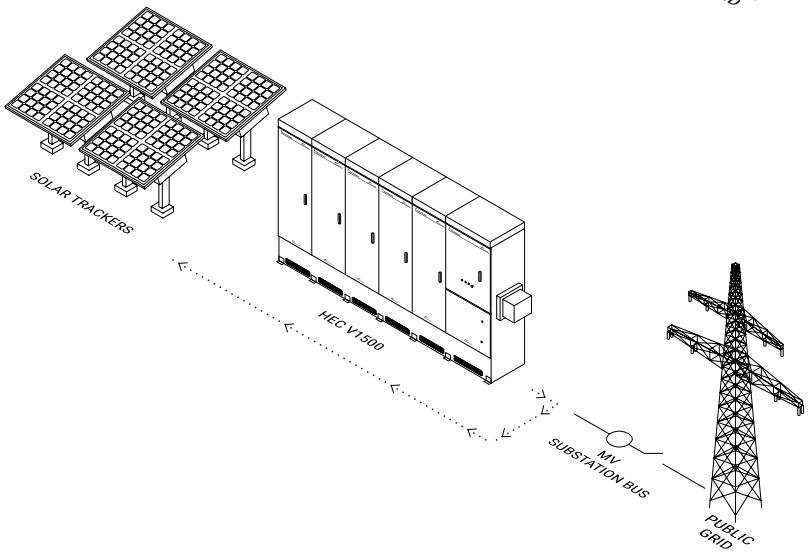
BACK FEED TRACKER SUPPLY

During solar power plant normal operation, the solar trackers are powered by the grid via the auxiliary service transformer. In case of a loss of mains, a UPS with battery systems is needed for powering the solar trackers and ensures achieving the safety position. Battery systems increase the CAPEX and the OPEX of the project, due to a high maintenance requirement, extra energy consumption and battery replacement. In order to avoid these disadvantages, HEC V1500 inverter is able to provide the safety power supply required without using battery systems, taking profit of the energy available in the PV field, and therefore offering the most cost-effective solution in the market.

PLANT UNDER OPERATION



BLACKOUT EVENT

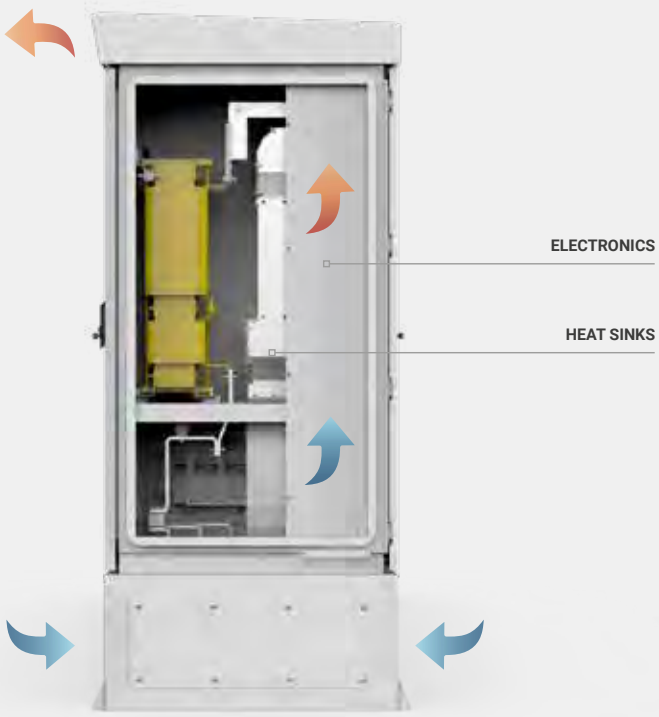


..... **Energy Flow**

REVOLUTIONARY COOLING SYSTEM

The Power Electronics HEC V1500 series includes the innovative and sophisticated iCOOL V performance that allows HEC V1500 to work up to 50°C at nominal power. The cooling system, iCOOL V, smartly cools the inverter, regulating the cooling system capacity depending on the data from the temperature sensors. HEC V1500 modules are divided into two main areas: clean area (electronics) and hot area (heat sink). The electronics are totally sealed and use a temperature control low flow cooling system that reduces filters clogging and maintenance intervals. The hot area integrates a speed controlled fan for each module, simplifying the cooling system and reducing the maintenance tasks. Furthermore, due to the modular topology, the iCOOL V reduces the Stand-by consumption at low capacity to the maximum, boosting the cooling capacity for photovoltaic installations situated up to 4000 meters above sea level.

PATENT PENDING



VAR AT NIGHT

At night, the HEC V1500 inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

HIGH MODULARITY SYSTEM

The HEC V1500 inverter family is a high modularity solution with its 25 different models based on 5 frames, from 3 up to 7 power modules. With its modular and flexible design, Power Electronic offers a smart solution for meeting all our clients' needs, providing high modularity and redundancy to any solar power plant.

Its extensive product range, a wide power and voltage range and a redundant control system, makes the HEC V1500 inverter family an optimal solution to guarantee high availability in every small-medium utility scale project.

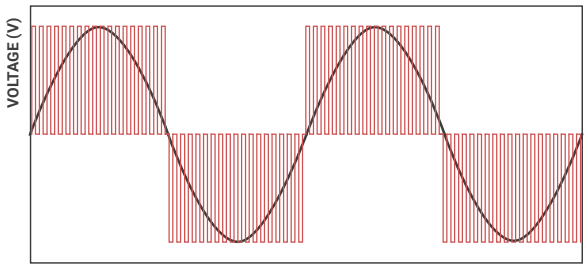
FROM 1MW

UP TO 3.5MW

MULTILEVEL TOPOLOGY

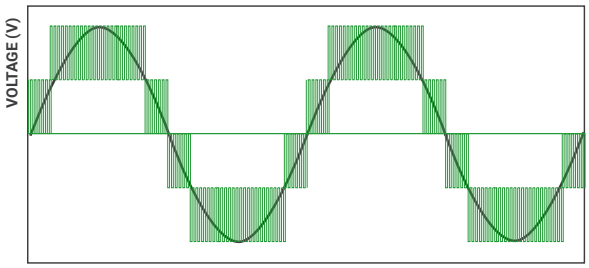
The multilevel IGBT topology makes the difference when the DC voltage is above 1000V, being the most efficient way to manage high DC link voltages. Based in our long IGBT experience components used in our Solar and Industrial division, the HEC V1500 takes profit of the three level IGBT topology reducing the power stage losses, increasing the efficiency and offering a very low total harmonic distortion.

TWO-LEVEL INVERTER



OTHER INVERTER

THREE-LEVEL INVERTER



POWER ELECTRONICS SOLUTION

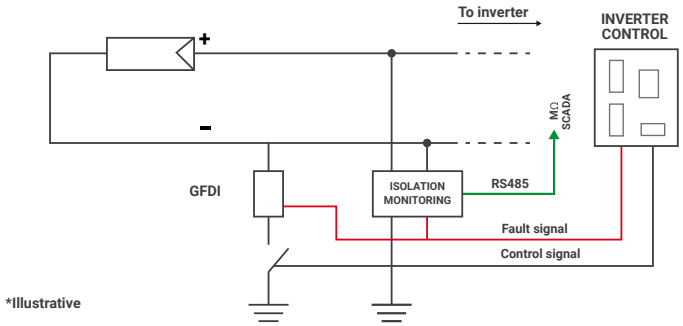
ACTIVE HEATING

At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PATENTED**

PV ARRAY TRANSFER KIT

By mounting this kit, the inverter and the PV plant will be able to shift its running conditions from negative grounded array to floating array and viceversa. Under regular conditions the inverter will be running with a negative pole grounded and therefore, a GDFI will provide protection against unlikely ground fault defects and the solar cells will not suffer a negative voltage relative to their surroundings at any time. This running mode can be transfered to a floating array configuration enabling an isolation monitoring device that the O&M can use for: regular PV plant isolation control, identification of the array affected by a ground fault defect and most important, increase the operator safety under O&M service activities.



EASY TO MONITOR

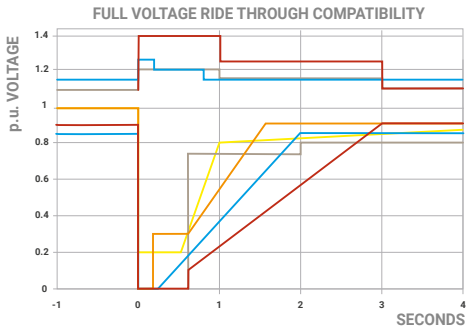
The Freesun app is the easiest way to monitor the status of our inverters. All our inverters come with built-in wifi, allowing remote connectivity to any smart device for detailed updates and information without the need to open cabinet doors.

The app user friendly interface allows quick and easy access to critical information (energy registers, production and events).

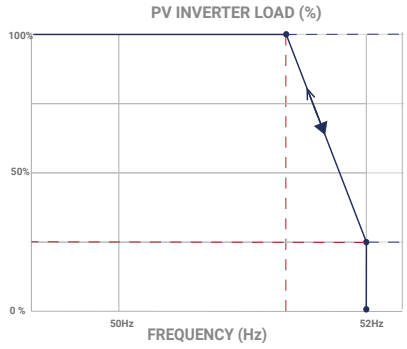
AVAILABLE INFORMATION	Grid and PV field data. Inverter and Power module data (Voltages, currents, power, temperatures, I/O status...). Weather conditions. Alarms and warnings events. Energy registers. Others.
FEATURES	Easy Wireless connection. Comprehensive interface. Real time data. Save and copy settings.
LANGUAGE	English, Spanish.
SYSTEM REQUIREMENTS	iOS or Android devices.
SETTINGS CONTROL	Yes

DYNAMIC GRID SUPPORT

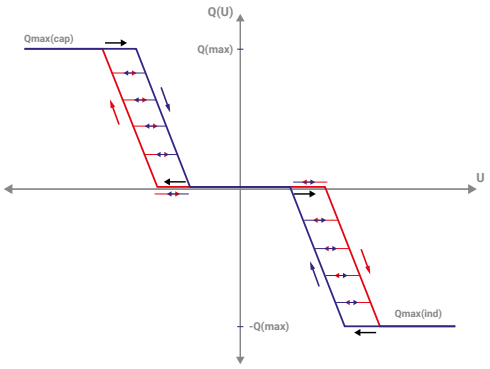
HEC V1500 firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment…), and can be configured to meet specific utility requirements.

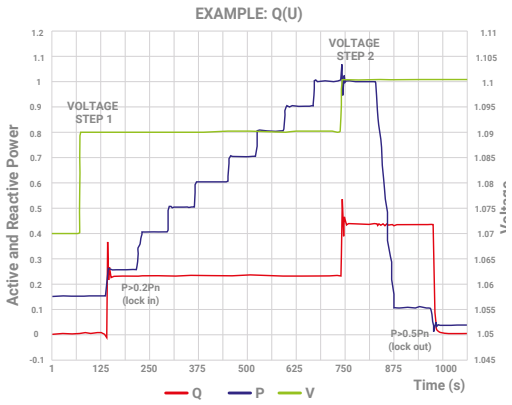


Low Voltage Ride Through (LVRT or ZVRT). Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive current, as long as the protection limits are not exceeded.

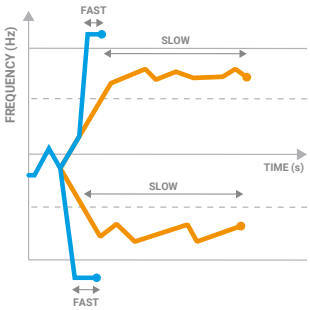


Frequency Regulation System (FRS). Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

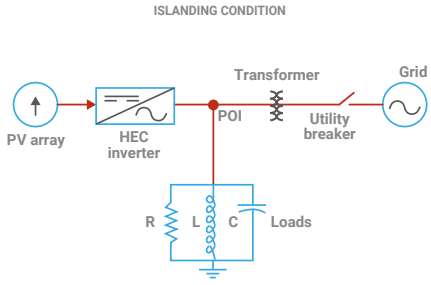




Q(V) curve. It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



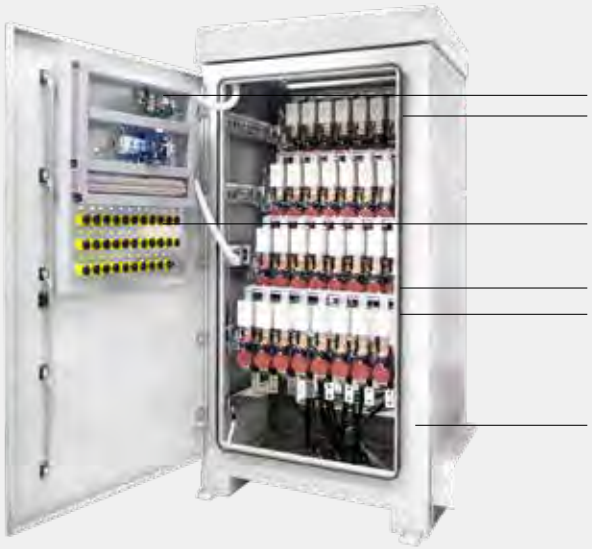
Frequency Ride Through (FRT). Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



Anti-islanding. This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

DISCONNECTION AND PROTECTION

HEC V1500 is available with an external DC disconnection and protection unit (DU unit) that will be coupled together with the inverter by a mounting kit. The DC subsystems are fully customizable and can be featured with up to 32 inputs. The disconnecting unit goes one step further by improving the PV plant safety and operation for those who apply the best engineering.



TECHNICAL INFORMATION

Voltage rating	1500 Vdc
Maximum number of inputs	Frame 1: 16 inputs Frame 2: 32 inputs
Maximum DC continuous current	3745A
Maximum DC short circuit current	5450A
Maximum fuse size per input	400A
Max. positive and negative input wire size	2 x 750 kcmil - 380mm2 (Check Installation Manual for further information)
Terminals	2 holes - 1.75" hole spacing
String configuration	Floating array / Possitive or negative pole grounded
Floating array protection	Insulation monitoring device
Grounded array protection	GFDI / GFDI + Insulation monitoring device (NEC 2014) optional
Operating temperature	-35°C to 60°C
Zone monitoring	Optional (Voltage and current monitoring)
DC disconnect	400A DC contactor
Input disable capability	2 push buttons in Frame 1 4 push buttons in Frame 2 Other confi gurations optional
Fuse mounting	Up to 32 x Busbar bolted
Cooling	Forced air cooling, temperature controlled
Heating	Heating resistor
Type	IEC / UL

CONFIGURATION TABLE

FAMILY		Freesun Disconnnecting Unit							
SERIES	**C**	HEC Series							
TYPE	**U**	UL	**H**	IEC					
MAXIMUN VOLTAGE	**15**	1500V							
INPUTS PER POLE	**01**	1 Input	**...**	...	**32**	32 Inputs			
STRING LOCKOUT AND TAGOUT	**A**	Standard (1 input per tray)	**B**	3 Push buttons	**C**	4 Push buttons	**...**	...	**Z** 1 Pushbutton per Input
LIGHTNING AND OVERVOLTAGE PROTECTIONS	**O**	Type 2	**L**	Type 1					
ZONE MONITORING	**N**	Not included	**C**	Current Monitoring					
INSULATION MONITORING	**I**	Insulation Monitoring (Floating Array)	**G**	GFDI + Insulation Monitoring (negative pole grounded)					
PAINT AND CORROSION PROTECTION	**A**	C4	**M**	C5M					

INSULATION MONITORING DEVICE

Insulation monitoring can detect cable insulation issues in the PV array. If low insulation resistance is detected between the array and ground, the device disconnects the inverter and writes a fault message in the system fault log. In grounded systems, an additional contactor connected in series with the GFDI disconnects the pole from the ground every morning, prior to the startup sequence of the inverter, in order to allow the monitoring device to check the insulation between both poles and ground.

VOLTAGE AND CURRENT MONITORING

The FSDK Voltage and Current monitoring option provides data for zone current values, as well as the open circuit voltage for every DC input. DC Voltage and current monitoring allows an operator to safely check the PV array operation without opening the DC cabinet. With the Voltage and Current monitoring option, a remote SCADA operator will be able to receive fault messages like “unbalanced currents”, “unbalanced voltages” or “blown fuse” and take appropriate action based on the status of the PV field.

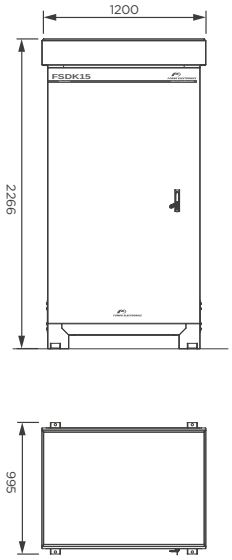
LOW STRING INSULATION DETECTOR

Using the individual DC contactors and the Insulation Monitoring option, the FSDK unit can automatically identify which input has low insulation and isolate it from the rest of the PV field. After the faulted line is disconnected, the inverter will log the error and send a warning to the O&M team to provide information about the faulty input. Detailed troubleshooting information will reduce service time and quickly get a system back on-line.

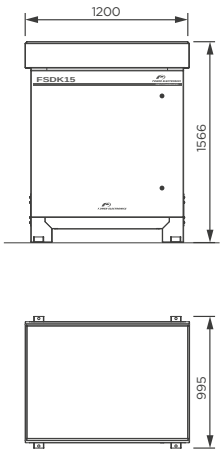
PATENTED

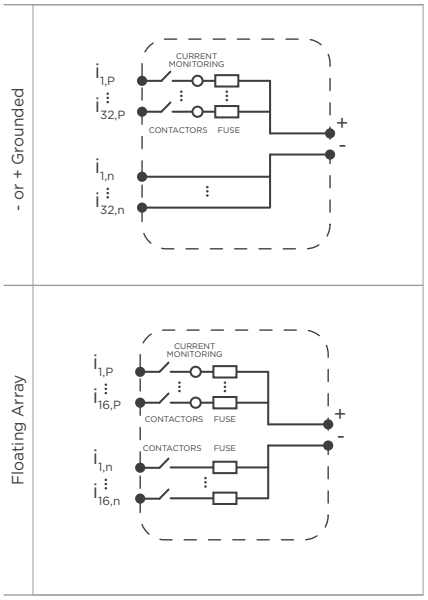
DIMENSIONS & DIAGRAM

FRAME 2



FRAME 1





TECHNICAL CHARACTERISTICS

HEC V1500 - 690V

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1275CH15**	**FS1700CH15**	**FS2125CH15**	**FS2550CH15**	**FS3000CH15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1275	1700	2125	2550	3000
	AC Output Power (kVA/kW) @25°C [1]	1530	2040	2550	3060	3500
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	690V ±10%				
	Operating Grid Frequency (Hz)	50Hz/60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	976V - 1310V				
	Maximum DC voltage	1500V				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.8%				
	Euroeta (η)	98.7%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	400V / 230VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	IP54				
	Permissible Ambient Temperature	-35°C[3] to 60°C / Active Power derating >50°C				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP/IP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV Array (Positive pole and negative pole): GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	IEC62109-1, IEC62109-2				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC V1500 - 645V

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1200CH15**	**FS1600CH15**	**FS2000CH15**	**FS2400CH15**	**FS2800CH15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1200	1600	2000	2400	2800
	AC Output Power (kVA/kW) @25°C [1]	1430	1910	2390	2860	3345
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	645V ±10%				
	Operating Grid Frequency (Hz)	50Hz/60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	913V - 1310V				
	Maximum DC voltage	1500V				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.7%				
	Euroeta (η)	98.6%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	400V / 230VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	IP54				
	Permissible Ambient Temperature	-35°C[3] to 60°C / Active Power derating >50°C				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP/IP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV Array (Positive pole and negative pole): GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	IEC62109-1, IEC62109-2				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC V1500 - 630V

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1270CH15**	**FS1695CH15**	**FS2120CH15**	**FS2540CH15**	**FS3001CH15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1180	1570	1965	2360	2750
	AC Output Power (kVA/kW) @40°C [1]	1270	1695	2120	2540	3000
	AC Output Power (kVA/kW) @25°C [1]	1400	1870	2340	2800	3275
	Max. AC Output Current (A) @50°C	1080	1440	1800	2160	2520
	Max. AC Output Current (A) @40°C	1165	1550	1940	2330	2715
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	630V ±10%				
	Operating Grid Frequency (Hz)	50Hz/60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0…100% / 0.1% Steps				
INPUT	MPPt @full power (VDC)	@50°C 891V-1310V / @40°C 891V-1285V / @25°C 891V-1250V				
	Maximum DC voltage	1500V				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η) Preliminary	98.6%				
	Euroeta (η) Preliminary	98.6%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	400V / 230VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	IP54				
	Permissible Ambient Temperature	-35°C[3] to +60°C / Power derating >40°C				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	IEC62109-1, IEC62109-2				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC V1500 - 600V

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1100CH15**	**FS1475CH15**	**FS1850CH15**	**FS2225CH15**	**FS2600CH15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1100	1475	1850	2225	2600
	AC Output Power (kVA/kW) @25°C [1]	1335	1780	2225	2660	3110
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	600V ±10%				
	Operating Grid Frequency (Hz)	50Hz/60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	849V - 1310V				
	Maximum DC voltage	1500V				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.6%				
	Euroeta (η)	98.6%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	400V / 230VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	IP54				
	Permissible Ambient Temperature	-35°C[3] to 60°C / Active Power derating >50°C				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP/IP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV Array (Positive pole and negative pole): GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	IEC62109-1, IEC62109-2				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC V1500 - 565V

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1050CH15**	**FS1400CH15**	**FS1750CH15**	**FS2100CH15**	**FS2450CH15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1050	1400	1750	2100	2450
	AC Output Power (kVA/kW) @25°C [1]	1250	1675	2090	2510	2930
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	565V ±10%				
	Operating Grid Frequency (Hz)	50Hz/60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	800V - 1310V				
	Maximum DC voltage	1500V				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.5%				
	Euroeta (η)	98.4%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	400V / 230VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	IP54				
	Permissible Ambient Temperature	-35°C[3] to 60°C / Active Power derating >50°C				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP/IP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV Array (Positive pole and negative pole): GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	IEC62109-1, IEC62109-2				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US V1500 - 690V

NORTH AMERICA

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1275CU15**	**FS1700CU15**	**FS2125CU15**	**FS2550CU15**	**FS3000CU15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1275	1700	2125	2550	3000
	AC Output Power (kVA/kW) @25°C [1]	1530	2040	2550	3060	3500
	AC Output Power (kW) @50°C; PF=0.9	1150	1530	1910	2250	2700
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	690V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	976V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1100V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.5%	98.7%	98.7%	98.7%	98.7%
	CEC (η)	98.0%	98.5%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US V1500 - 645V

NORTH AMERICA

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1200CU15**	**FS1600CU15**	**FS2000CU15**	**FS2400CU15**	**FS2800CU15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1200	1600	2000	2400	2800
	AC Output Power (kVA/kW) @25°C [1]	1430	1910	2390	2860	3345
	AC Output Power (kW) @50°C; PF=0.9	1080	1440	1800	2160	2520
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	645V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0…100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	913V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1075V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.4%	98.5%	98.6%	98.6%	98.6%
	CEC (η)	98.0%	98.0%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US V1500 - 630V

NORTH AMERICA

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1270CU15**	**FS1695CU15**	**FS2120CU15**	**FS2540CU15**	**FS3001CU15**
OUTPUT	AC Output Power (kVA/kW) @50°C [1]	1180	1570	1965	2360	2750
	AC Output Power (kVA/kW) @40°C [1]	1270	1695	2120	2540	3000
	AC Output Power (kVA/kW) @25°C [1]	1400	1870	2340	2800	3275
	Max. AC Output Current (A) @50°C	1080	1440	1800	2160	2520
	Max. AC Output Current (A) @40°C	1165	1550	1940	2330	2715
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	630V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0…100% / 0.1% Steps				
INPUT	MPPt @full power (VDC)	@50°C 891V-1310V / @40°C 891V-1285V / @25°C 891V-1250V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1050V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η) Preliminary	98.5%				
	CEC (η) Preliminary	98.5%				
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Power derating >40°C/104°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Compatible with third party SCADA controls				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US V1500 - 600V

NORTH AMERICA

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1100CU15**	**FS1475CU15**	**FS1850CU15**	**FS2225CU15**	**FS2600CU15**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1100	1475	1850	2225	2600
	AC Output Power(kVA/kW) @25°C [1]	1335	1780	2225	2660	3110
	AC Output Power(kW) @50°C; PF=0.9	990	1325	1665	2000	2340
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	600V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0…100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	849V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1050V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.4%	98.5%	98.6%	98.6%	98.6%
	CEC (η)	98.0%	98.0%	98.5%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US V1500 - 565V

NORTH AMERICA

		FRAME 1	FRAME 2	FRAME 3	FRAME 4	FRAME 5
NUMBER OF MODULES		**3**	**4**	**5**	**6**	**7**
REFERENCE		**FS1050CU15**	**FS1400CU15**	**FS1750CU15**	**FS2100CU15**	**FS2450CU15**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1050	1400	1750	2100	2450
	AC Output Power(kVA/kW) @25°C [1]	1250	1675	2090	2510	2930
	AC Output Power(kW) @50°C; PF=0.9	945	1260	1575	1890	2205
	Max. AC Output Current (A) @25°C	1285	1710	2140	2570	3000
	Operating Grid Voltage (VAC)	565V ±10%				
	Operating Grid Frequency (Hz)	60Hz				
	Current Harmonic Distortion (THDi)	< 3% per IEEE519				
	Power Factor (cosine phi) [2]	0.0 leading … 0.0 lagging / Reactive Power injection at night				
	Power Curtailment	0...100% / 0.1% Steps				
INPUT	MPPt @full power (VDC) [1]	800V - 1310V				
	Maximum DC voltage	1500V				
	Minimum Start Voltage	1075V - User configurable				
	Max. DC continuous current (A)	1600	2140	2675	3210	3745
	Max. DC short circuit current (A)	2320	3100	3880	4650	5450
EFFICIENCY & AUXILIARY SUPPLY	Efficiency (Max) (η)	98.2%	98.4%	98.5%	98.5%	98.5%
	CEC (η)	98.0%	98.0%	98.0%	98.5%	98.5%
	Max. Standby Consumption (Pnight)	< approx. 50W/per module				
	Control Power Supply	120V / 208VAC–6kVA power supply available for external equipment (optional)				
CABINET	Dimensions [WxDxH] [inches]	119.6"x37.2"x86.5"	147.6"x37.2"x86.5"	175.7"x37.2"x86.5"	203.8"x37.2"x86.5"	231.9"x37.2"x86.5"
	Dimensions [WxDxH] [mm]	3038x945x2198	3751x945x2198	4464x945x2198	5177x945x2198	5890x945x2198
	Weight (kg)	2635	3290	3945	4600	5255
	Weight (lbs)	5809	7253	8697	10141	11585
	Air Flow	Bottom intake. Exhaust top rear vent.				
	Type of ventilation	Forced air cooling				
ENVIRONMENT	Degree of protection	NEMA 3R				
	Permissible Ambient Temperature	-31°F to +140°F, -35°C[3] to +60°C / Active Power derating >50°C/122°F				
	Relative Humidity	0% to 100% non condensing				
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)				
	Noise level [4]	< 79 dBA				
CONTROL INTERFACE	Interface	Graphic Display (inside cabinet) / Optional Freesun App				
	Communication protocol	Modbus TCP				
	Power Plant Controller	Optional				
	Keyed ON/OFF switch	Standard				
	Digital I/O	User configurable				
	Analog I/O	User configurable				
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device				
	Humidity control	Active Heating				
	General AC Protection & Disconn.	Circuit Breaker				
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet				
	Module AC Protection & Disconn.	AC contactor & fuses				
	Module DC Protection	DC fuses				
	Overvoltage Protection	AC and DC protection (type 2)				
CERTIFICATIONS	Safety	UL 1741, CSA 22.2 No.107.1-01, UL62109-1				
	Utility interconnect	UL 1741SA-Sept. 2016 / IEEE 1547.1-2005				

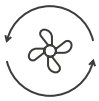
[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.


POWER ELECTRONICS

HEC PLUS

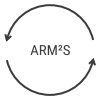
UTILITY SCALE SOLAR INVERTER

OUTDOOR DURABILITY



ICOOL

ACTIVE HEATING



AUTOMATIC REDUNDANT
MODULAR MULTI-MASTER SYSTEM

THE MOST POWERFUL AND RELIABLE UTILITY-SCALE PV INVERTER ON THE MARKET

Power Electronics' HEC PLUS outdoor modular and redundant inverters are the most powerful and reliable Utility Scale PV Inverters on the market. The upgraded 1000Vdc class inverters offer an extended MPPt voltage range and maximum efficiency in AC output voltages ranging from 400Vac to 460Vac, covering all commercial and utility-scale PV facilities.

The HEC PLUS is based on a modular & redundant topology with up to 10 modules that provide the competitiveness of central inverters and the availability of string inverters. The HEC PLUS is featured with an outdoor stainless steel enclosure, 50mm mineral isolation panel and the most advanced iCOOL filter-less system that makes it suitable for the most demanding conditions.

ROBUST DESIGN

Polymeric Painting

Mineral Panel

Galvanized Steel | Stainless Steel (Optional)

HEC PLUS inverters have been designed to last for more than 25 years of operation in harsh environments and extreme weather conditions. HEC PLUS units are tested and ready to withstand conditions from the frozen siberian tundra to the californian Death Valley, featuring:

- Totally sealed electronics cabinet protects electronics against dust and moisture.
- Conformal coating on electronic boards shields PCBs from harsh atmospheres.
- Temperature and humidity controlled active heating prevents internal water condensation.
- Galvanized Steel construction with 2mm thickness for maximum enclosure longevity.
- 50mm mineral panel isolates the cabinet from solar heat gains.
- Roof cover designed to dissipate solar radiation, reduce heat build-up and avoid water leakages.
- The solid HEC PLUS structure avoids the need of additional external structures.
- Random units selected to pass a Factory Water Tightness Test ensuring product quality.
- Anti-corrosive polymeric C4 paint coat according to ISO 9223 used in the most unforgiving environments. The HEC PLUS is also available in a C5-M degree of protection by request.

TOPOLOGY

NO CONDENSATION

The active cabinet heating regulates temperature and prevents internal water condensation.

DOUBLE GASKETED DOORS

IP54 rated electronic area, protected from dust and moisture.

STAINLESS STEEL ENCLOSURE

Inox construction with 2mm thickness for maximum enclosure longevity.

SPECIAL PAINT

Anti-corrosive polymeric paint (C4) ISO-9223 is used on all HEC inverters.

INSULATION

50mm of insulation material protects internal components from external solar heat gains.

FSDK Recombiner

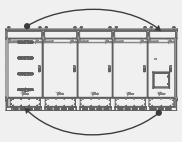
· Up to 32 fuse protected inputs.
· Zone monitoring. CT's in each input.
· Up to 32 contactors with lockout/ tagout safety features.

DC CABINET

TESTS
Random units are batch tested at the Factory for IP compliance.

CONFORMAL COATING
Conformal coating on electronic board shields PCBs from harsh environments.

MIRROR UNITS
Shift AC and DC modules to improve power station layout.



INVERTER MODULES

AC CABINET

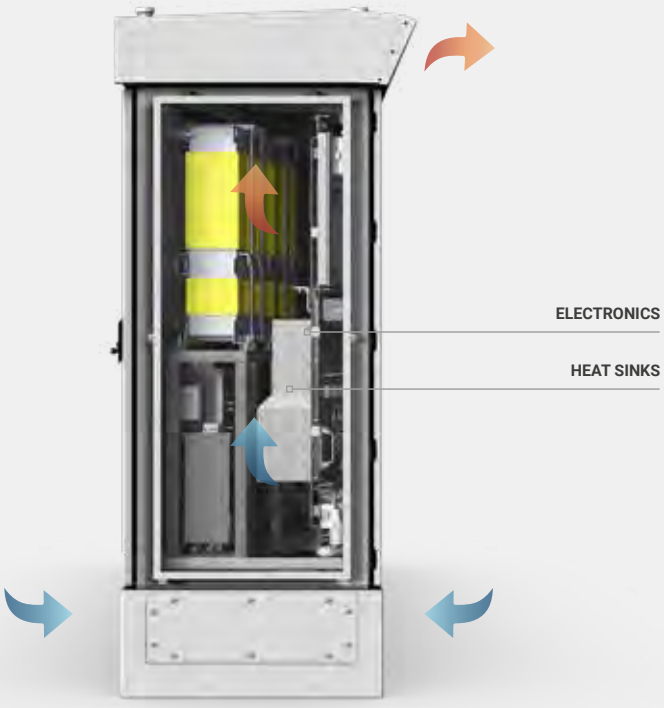
AUTOMATIC REDUNDANT MODULAR MULTI-MASTER SYSTEM

The HEC PLUS is a central inverter based on an Automatic Redundant Modular Multi-Master System (200kVA to 250kVA per module). The unit's redundant multi-master capability translates into more availability and therefore more power production. Modularity allows for the use of fewer type of components throughout the product range, reducing maintenance costs and simplifying the stock of spare parts.

INNOVATIVE COOLING SYSTEM

In Power Electronics we don't believe in cost cutting when it affects the quality of the product and that's why we oversize sensitive components and improve the sophisticated iCOOL performance that allow HEC PLUS to work at 50°C. Our know how in mining, water treatment plants and CSP facilities located in the most demanding locations all over the world have given us the necessary experience to develop the perfect technical solution for our outdoor solar inverters.

HEC PLUS modules are divided into two main areas: clean area (electronics) and hot area (filters and heat sink). The electronics are totally sealed and use a temperature control low flow cooling system that reduces filters clogging and maintenance intervals. The hot area integrates independent and speed controlled fans per each module, reducing to the maximum the Stand-by consumption at low capacity and boosting the cooling capacity for PV installation situated at higher altitudes than 3000 meters above sea level.

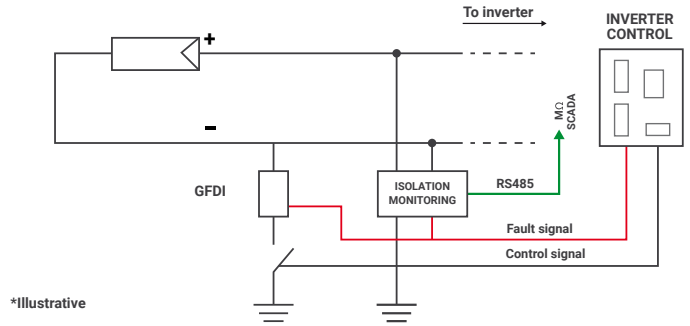


EASY TO SERVICE

By providing full front and rear access the HEC series simplifies the maintenance tasks. The frontal access allows the checking of the whole electronic cabinet (electronics boards, semiconductors, power supply, contactors...) while the rear access permits the revision of AC fuses and LCL filter.

PV ARRAY TRANSFER KIT

By mounting this kit, the inverter and the PV plant will be able to shift its running conditions from negative grounded array to floating array and viceversa. Under regular conditions the inverter will be running with a negative pole grounded and therefore, a GDFI will provide protection against unlikely ground fault defects and the solar cells will not suffer a negative voltage relative to their surroundings at any time. This running mode can be transfered to a floating array configuration enabling an isolation monitoring device that the O&M can use for: regular PV plant isolation control, identification of the array affected by a ground fault defect and most important, increase the operator safety under O&M service activities.



EXTENDED MPPT

Using the latest modulation techniques, inspired by the most accurate and powerful motor control applications, has lead to the widest MPPt full power window in the solar market. It allows optimal PV plant design and boosted performance rates.

ACTIVE HEATING

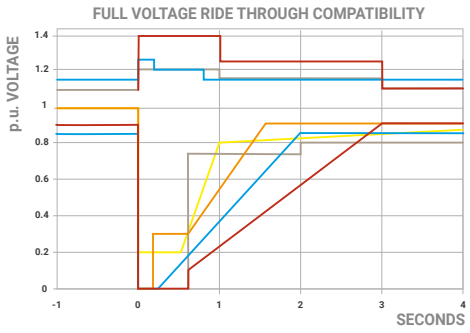
At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors. This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PATENTED**

VAR AT NIGHT

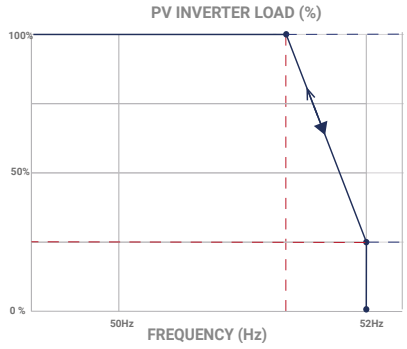
At night, the HEC PLUS inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

DYNAMIC GRID SUPPORT

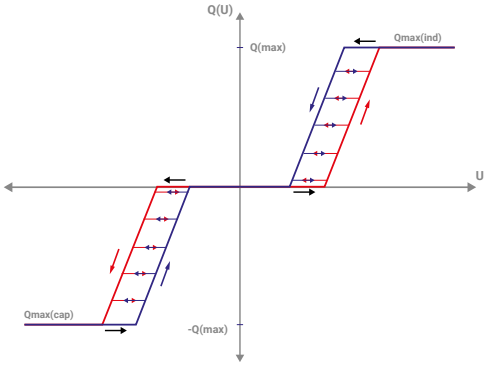
HEC PLUS firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment…), and can be configured to meet specific utility requirements.

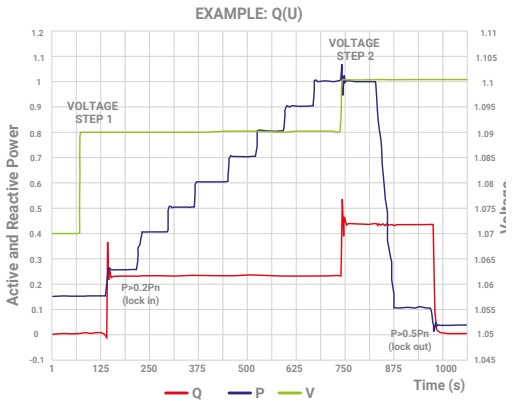


Low Voltage Ride Through (LVRT or ZVRT). Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive current, as long as the protection limits are not exceeded.

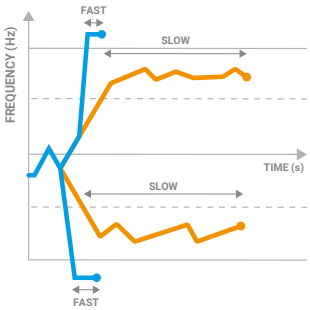


Frequency Regulation System (FRS). Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

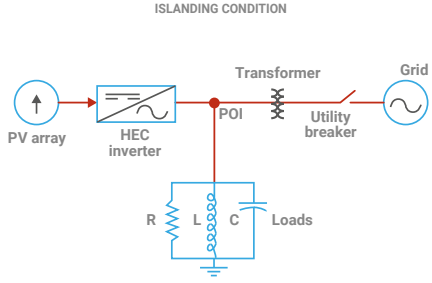




Q(V) curve. It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



Frequency Ride Through (FRT). Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



Anti-islanding. This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

DISCONNECTION AND PROTECTION

HEC PLUS is available with an external DC disconnection and protection unit (DU unit) that will be coupled together with the inverter by a mounting kit. The DC subsystems are fully customizable and can be featured with up to 40 inputs. The disconnecting unit goes one step further by improving the PV plant safety and operation for those who apply the best engineering.

TECHNICAL INFORMATION

Maximum DC Current (A):	According to fuse rating
Maximum Continuous current (A)	According to fuse rating
Max. Possitive and Negative input Wire size	600kcmil / 300mm2
Max. Input wires	2 x 600kcmil per input
Operating Temperature	-20°C to 60°C
Zone Monitoring	Optional in each positive input
Lockout-tagout	One general as standard, other confi gurations optional
Fuse mounting	40xBusbar Bolted (US), 32xNH fuse base (IEC)
Terminals	Lugs Rated 90°C with 2 holes – 1.75” hole spacing
Cooling	Forced air cooling, temperature controlled, optional heating resistors
Avg. Consumption	82W (230Vac)

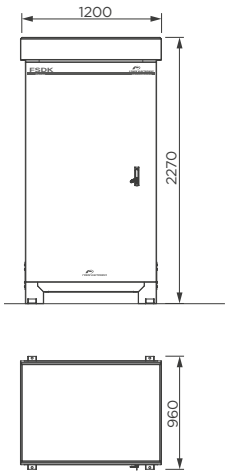
CONFIGURATION TABLE

FAMILY		FSDK Recombiner									
SERIES	**C**	HEC Series									
TYPE	**U**	UL	**J**	JAPAN	**H**	IEC					
MAXIMUM VOLTAGE	**10**	1000V									
FRAME	**1**	Frame 1	**2**	Frame 2							
INPUTS PER POLE	**01**	1 Input	**...**	...	**40**	40 Inputs					
STRING LOCKOUT AND TAGOUT	**A**	Standard (1 input per tray)	**B**	3 Push buttons	**C**	4 Push buttons	**...**	...	**Z**	1 Push button per Input	
LIGHTNING AND OVERVOLTAGE PROTECTIONS	**O**	Type 2	**L**	Type 1 + Type 2							
ZONE MONITORING	**N**	Not included	**C**	Voltage and Current Monitoring	**I**	Voltage and Current Monitoring + Low String Insulation Detector					
INSULATION MONITORING	**I**	Basic Insulation Monitoring Device	**M**	Insulation Monitoring and Measurement Device	**G**	GFDI	**N**	GFDI + Insulation Monitoring and Measurment Device			
	Floating array				Negative grounding						
PAINT AND CORROSION PROTECTION	**A**	C4 - RAL7035	**B**	C4 - RAL6013	**C**	C4 - RAL6005	**M**	C5M - RAL7035	**N**	C5M - RAL6013	**O** C5M - RAL6005
INVERTER CONNECTION	**S**	Standard	**Y**	Symmetrical							
EXTERNAL METERING	**N**	Not Included	**I**	Included							

DIMENSIONS & DIAGRAM

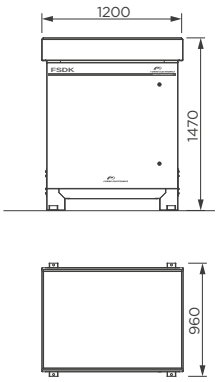
FRAME 2

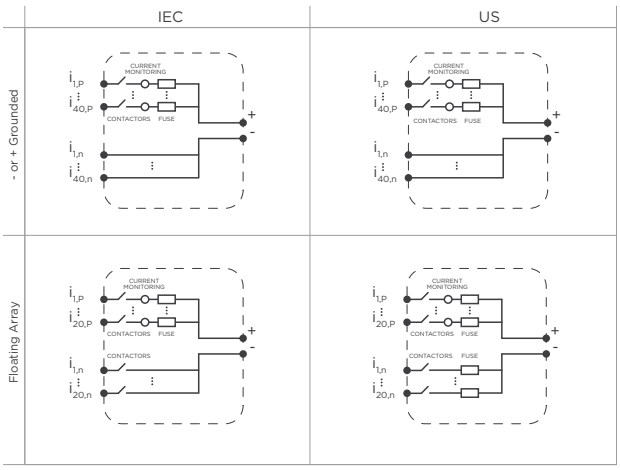
(21 to 40 fuse protected input)



FRAME 1

(1 to 20 fuse protected input)

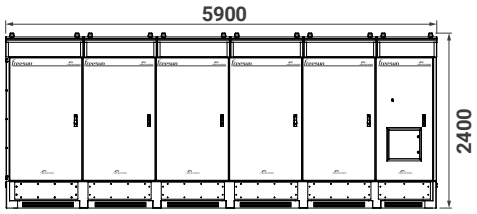




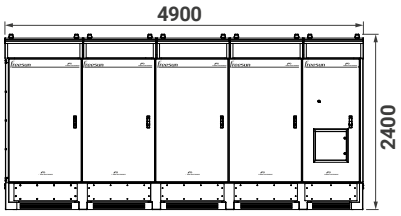
FRAMES AND DIMENSIONS

HEC PLUS

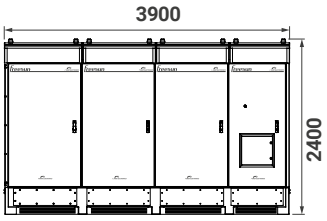
FRAME 4



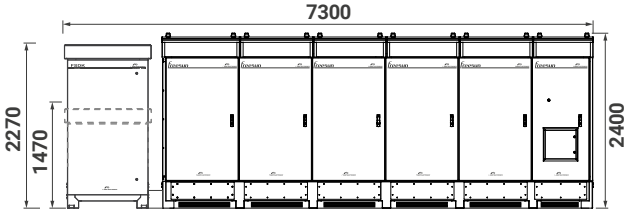
FRAME 3

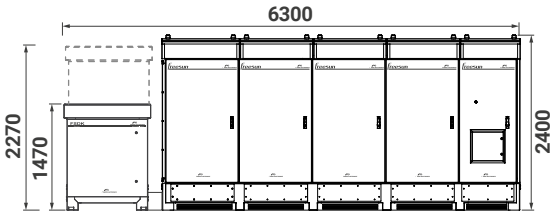


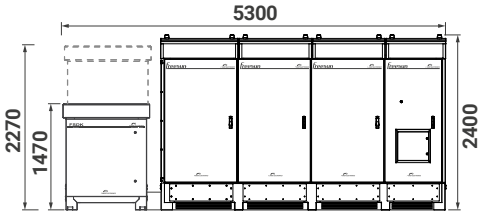
FRAME 2



HEC PLUS + FSDK







Depth of all units is 1020mm.

TECHNICAL CHARACTERISTICS

HEC PLUS - 460V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1162CH**	**FS1391CH**	**FS1620CH**	**FS1850CH**	**FS2081CH**	**FS2300CH**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1160	1390	1620	1850	2080	2300
	AC Output Power(kVA/kW) @25°C [1]	1270	1530	1780	2040	2290	2550
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	460Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion(THDi)	< 3% at any load condition					
	Power Factor (cosine phi) [2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC) [1]	651V-900V					
	MPPt window @full power (VDC) [1]	671V–820V @50°C / 744V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	400V/230VAC–1kVA user power supply available, Optional 6kVA					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Intake through lower part blown out through upper side					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	IP54					
	Permissible Ambient Temperature	-30°C [3] to +60°C / >50°C Active Power derating					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC PLUS - 440V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1112CH**	**FS1331CH**	**FS1550CH**	**FS1770CH**	**FS1991CH**	**FS2200CH**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1110	1330	1550	1770	1990	2200
	AC Output Power(kVA/kW) @25°C [1]	1220	1460	1710	1950	2190	2440
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	440Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion (THDi)	< 3% at any load condition					
	Power Factor (cosine phi) [2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC) [1]	623V-900V					
	MPPt window @full power (VDC) [1]	642V–820V @50°C / 712V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	400V/230VAC–1kVA user power supply available, Optional 6kVA					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Intake through lower part blown out through upper side					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	IP54					
	Permissible Ambient Temperature	-30°C [3] to +60°C / >50°C Active Power derating					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDI and Isolation monitoring device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC PLUS - 420V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1051CH**	**FS1271CH**	**FS1480CH**	**FS1690CH**	**FS1901CH**	**FS2200CH**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1050	1270	1480	1690	1900	2110
	AC Output Power(kVA/kW) @25°C [1]	1160	1400	1630	1860	2100	2330
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	420Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion (THDi)	< 3% at any load condition					
	Power Factor (cosine phi) [2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC) [1]	623V-900V					
	MPPt window @full power (VDC) [1]	616V–820V @50°C / 680V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	400V/230VAC–1kVA user power supply available, Optional 6kVA					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Intake through lower part blown out through upper side					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	IP54					
	Permissible Ambient Temperature	-30°C [3] to +60°C / >50°C Active Power derating					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDI and Isolation monitoring device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS HEC PLUS - 400V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1003CH**	**FS1201CH**	**FS1401CH**	**FS1600CH**	**FS1800CH**	**FS2000CH**
OUTPUT	AC Output Power(kVA/kW) @50°C [1]	1000	1200	1400	1600	1800	2000
	AC Output Power(kVA/kW) @25°C [1]	1110	1330	1550	1770	2000	2220
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	400Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion (THDi)	< 3% at any load condition					
	Power Factor (cosine phi) [2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC) [1]	566V-900V					
	MPPt window @full power (VDC) [1]	584V–820V @50°C / 648V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	400V/230VAC–1kVA user power supply available, Optional 6kVA					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Intake through lower part blown out through upper side					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	IP54					
	Permissible Ambient Temperature	-30°C [3] to +60°C / >50°C Active Power derating					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDI and Isolation monitoring device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US PLUS - 440V

NORTH AMERICA

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1112CU**	**FS1331CU**	**FS1550CU**	**FS1770CU**	**FS1991CU**	**FS2200CU**
OUTPUT	AC Output Power(kVA/kW) @50°C	1110	1330	1550	1770	1990	2200
	AC Output Power(kVA/kW) @25°C	1220	1460	1710	1950	2190	2440
	Max. Power (kW@PF=0.9, @50°C)	1000	1190	1390	1590	1790	1980
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	440Vac ±10%					
	Operating Grid Frequency	60Hz					
	Current Harmonic Distortion (THDi)	< 3% per IEEE519					
	Power Factor (cosine phi) [1]	0.00 leading … 0.00 lagging adjustable/ Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC) [2]	623V-900V					
	MPPt window @full power (VDC) [2]	642V–820V @50°C / 712V–820V @25°C					
	Maximum DC Voltage	1000V					
	Minimum Start Voltage	700V - User configurable					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%					
	Euroeta (η)	98.3%		98.4%			
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	120V / 208VAC–1kVA power supply available for external equipment					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
CABINET	Dimensions [WxDxH] [ft]	153.5"x40.12"x94.5"		192.9"x40.12"x94.5"		232.3"x40.12"x94.5"	
	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (lbs)	7804	8487	10119	10802	12434	13117
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Bottom intake. Exhaust top vent (Front or Rear option)					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	NEMA 3R					
	Permissible Ambient Temperature	-22°F to +122°F, -30°C[3] to +50°C / Active Power derating >50°C/122°F					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	1000m; >1000m power derating 1% Sn (kVA) per 100m					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display (inside cabinet) / Optional Freesun App					
	Communication Protocol	RS232 / RS485 / USB / Ethernet, (Modbus RTU, Modbus TCP/IP)					
	Power Plant Controller	Optional					
	Keyed ON/OFF switch	Standard					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device					
	Humidity control	Active Heating					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet (FSDK)					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC and DC protection (type 2)					
CERTIFICATIONS	Safety	UL 1741; CSA 22.2 No.107.1-01					
	Utility interconnect	IEEE 1547 with Utility Interactive Control functions					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US PLUS - 420V

NORTH AMERICA

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1051CU**	**FS1271CU**	**FS1480CU**	**FS1690CU**	**FS1901CU**	**FS2110CU**
OUTPUT	AC Output Power(kVA/kW) @50°C	1050	1270	1480	1690	1900	2110
	AC Output Power(kVA/kW) @25°C	1160	1400	1630	1860	2100	2330
	Max. Power (kW@PF=0.9, @50°C)	940	1140	1330	1520	1710	1900
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	420Vac ±10%					
	Operating Grid Frequency	60Hz					
	Current Harmonic Distortion (THDi)	< 3% per IEEE519					
	Power Factor (cosine phi)[1]	0.00 leading … 0.00 lagging adjustable/ Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[2]	594V-900V					
	MPPt window @full power (VDC)[2]	616V–820V @50°C / 680V–820V @25°C					
	Maximum DC Voltage	1000V					
	Minimum Start Voltage	700V - User configurable					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%					
	Euroeta (η)	98.3%		98.4%			
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	120V / 208VAC–1kVA power supply available for external equipment					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
CABINET	Dimensions [WxDxH] [inches]	153.5”x40.12”x94.5”		192.9”x40.12”x94.5”		232.3”x40.12”x94.5”	
	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (lbs)	7804	8487	10119	10802	12434	13117
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Bottom intake. Exhaust top vent (Front or Rear option)					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	NEMA 3R					
	Permissible Ambient Temperature	-22°F to +122°F, -30°C[3] to +50°C / Active Power derating >50°C/122°F					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	1000m; >1000m power derating 1% Sn (kVA) per 100m					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display (inside cabinet) / Optional Freesun App					
	Communication Protocol	RS232 / RS485 / USB / Ethernet, (Modbus RTU, Modbus TCP/IP)					
	Power Plant Controller	Optional					
	Keyed ON/OFF switch	Standard					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device					
	Humidity control	Active Heating					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet (FSDK)					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC and DC protection (type 2)					
CERTIFICATIONS	Safety	UL 1741; CSA 22.2 No.107.1-01					
	Utility interconnect	IEEE 1547 with Utility Interactive Control functions					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HEC-US PLUS - 400V

NORTH AMERICA

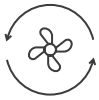
		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1004CU**	**FS1201CU**	**FS1401CU**	**FS1600CU**	**FS1801CU**	**FS2000CU**
OUTPUT	AC Output Power(kVA/kW) @50°C	1000	1200	1400	1600	1800	2000
	AC Output Power(kVA/kW) @25°C	1110	1330	1550	1770	2000	2220
	Max. Power (kW@PF=0.9, @50°C)	900	1080	1260	1440	1620	1800
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	400Vac ±10%					
	Operating Grid Frequency	60Hz					
	Current Harmonic Distortion (THDi)	< 3% per IEEE519					
	Power Factor (cosine phi)[1]	0.00 leading … 0.00 lagging adjustable/ Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[2]	566V-900V					
	MPPt window @full power (VDC)[2]	584V–820V @50°C / 648V–820V @25°C					
	Maximum DC Voltage	1000V					
	Minimum Start Voltage	700V - User configurable					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%					
	Euroeta (η)	98.3%		98.4%			
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	120V / 208VAC–1kVA power supply available for external equipment					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
CABINET	Max. Power Consumption	153.5"x40.12"x94.5"		192.9"x40.12"x94.5"		232.3"x40.12"x94.5"	
	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (lbs)	7804	8487	10119	10802	12434	13117
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Bottom intake. Exhaust top vent (Front or Rear option)					
	Type of ventilation	Forced air cooling					
ENVIRONMENT	Degree of protection	NEMA 3R					
	Permissible Ambient Temperature	-22°F to +122°F, -30°C[3] to +50°C / Active Power derating >50°C/122°F					
	Relative Humidity	0% to 100% non condensing					
	Max. Altitude (above sea level)	1000m; >1000m power derating 1% Sn (kVA) per 100m					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display (inside cabinet) / Optional Freesun App					
	Communication Protocol	RS232 / RS485 / USB / Ethernet, (Modbus RTU, Modbus TCP/IP)					
	Power Plant Controller	Optional					
	Keyed ON/OFF switch	Standard					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device					
	Humidity control	Active Heating					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet (FSDK)					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC and DC protection (type 2)					
CERTIFICATIONS	Safety	UL 1741; CSA 22.2 No.107.1-01					
	Utility interconnect	IEEE 1547 with Utility Interactive Control functions					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

HE PLUS

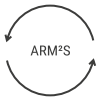
UTILITY SCALE SOLAR INVERTER

MULTI MPPT



ICOOL

ACTIVE HEATING



AUTOMATIC REDUNDANT
MODULAR MULTI-MASTER SYSTEM

INDOOR

PROACTIVE ATTITUDE

THE TRULY MODULAR INVERTER, WITH ALL SYSTEMS REPEATED IN EACH MODULE

The Power Electronics HE PLUS solar inverter is the best choice in quality and reliability. It is available in four output voltages from 400Vac to 460Vac, covering a power range from 1000kVA to 2550kVA. It is a truly redundant multi-master inverter. Designed for indoor applications, it simplifies maintenance tasks due to its extractable modules.

With the best in class topology and unique after-sales service in the market the HE PLUS represents the best guarantee for your investment.

TOPOLOGY

NO CONDENSATION

The Active cabinet heating regulates temperature and prevents internal water condensation.

WITHDRAWABLE MODULES

Withdrawable modules allow easy front access to all components reducing service time.

DC CLOSE COUPLING

Positive and negative terminals are ready for busbar or wiring connection

CONFORMAL COATING

Conformal coating on electronic board shields PCBs from harsh environments.

AC CLOSE COUPLING

The inverter can be easily connected to the transformer using an efficient busbar connection.

WIFI ROUTER

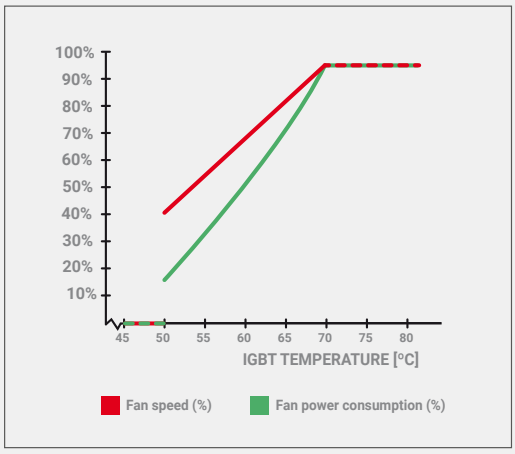
Wifi router allows the operator to connect remotely to the unit without entering the station.

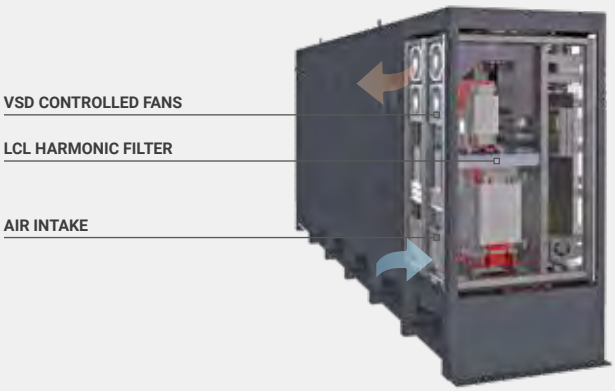
AUTOMATIC REDUNDANT MODULAR MULTI-MASTER SYSTEM

The HE PLUS is a central inverter based on an Automatic Redundant Modular Multi-Master System (200kVA to 250kVA per module). The unit's redundant multi-master capability translates into more availability and therefore more power production. Modularity allows for the use of fewer type of components throughout the product range, reducing maintenance costs and simplifying the stock of spare parts.

REVOLUTIONARY DIRECT REAR COOLING

Independent and temperature controlled VSD fans reduce significantly the auxiliary power consumption. A direct cooling flow to the outside reduce the station temperature.





ACTIVE HEATING

At night, when the unit is not actively exporting power, the inverter can import a small amount of power to keep the inverter internal ambient temperature above -20°C, without using external resistors.

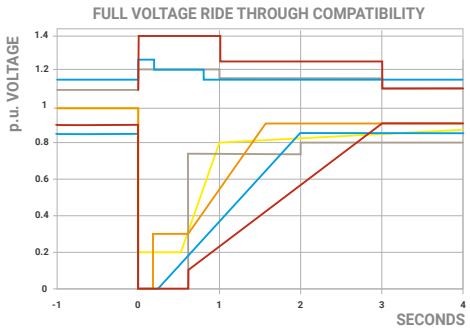
This autonomous heating system is the most efficient and homogeneous way to prevent condensation, increasing the inverters availability and reducing the maintenance. **PATENTED**

VAR AT NIGHT

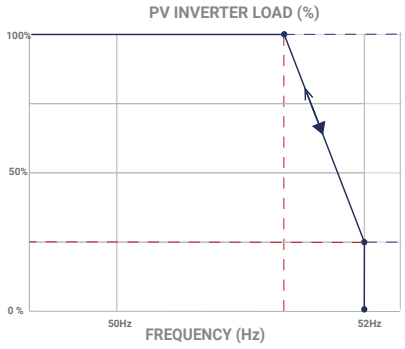
At night, the HE PLUS inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

DYNAMIC GRID SUPPORT

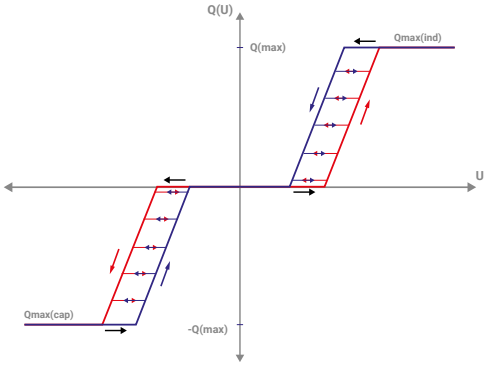
HE PLUS firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment…), and can be configured to meet specific utility requirements.

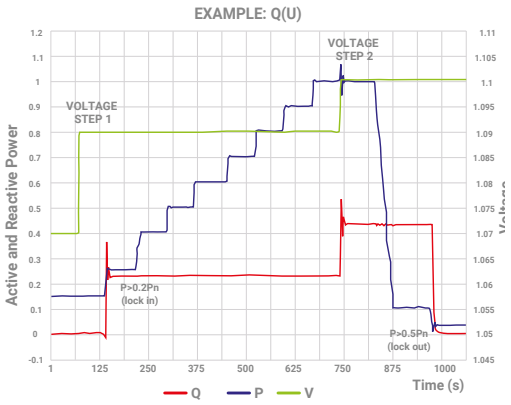


Low Voltage Ride Through (LVRT or ZVRT). Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive current, as long as the protection limits are not exceeded.

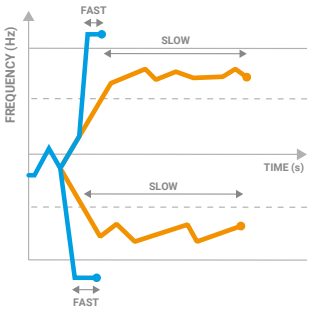


Frequency Regulation System (FRS). Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

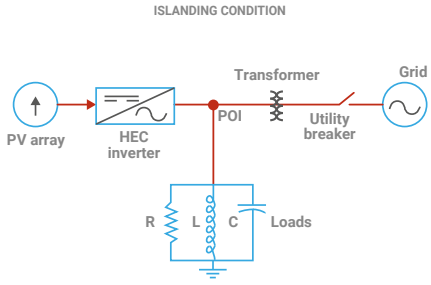




Q(V) curve. It is a dynamic voltage control function which provides reactive power in order to maintain the voltage as close as possible to its nominal value.



Frequency Ride Through (FRT). Freesun solar inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.



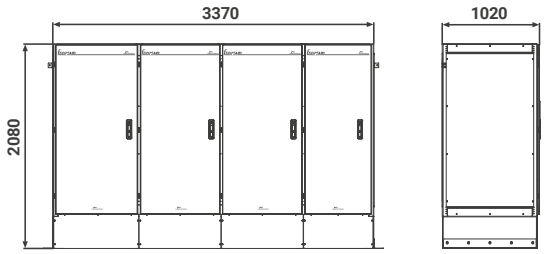
Anti-islanding. This protection combines passive and active methods that eliminates nuisance tripping and reduces grid distortion according to IEC 62116 and IEEE1547.

EASY TO SERVICE

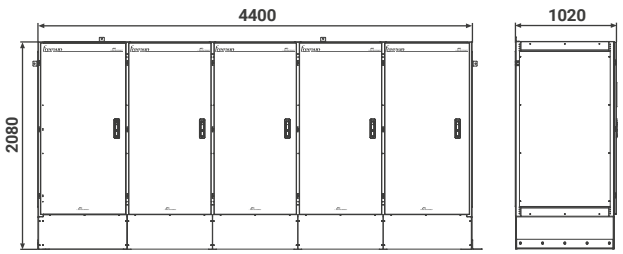
Its modular design allows for isolation and replacement of all the components with no effort, saving time and money during routine inspections. Each module is equipped with guided wheels that enable an easy frontal extraction only with the aid of the delivered trolley.

FRAMES AND DIMENSIONS

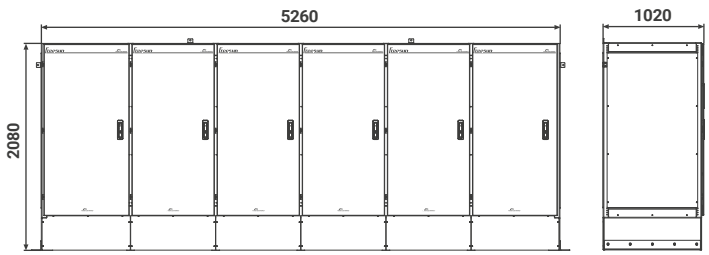
FRAME 2



FRAME 3



FRAME 4



TECHNICAL CHARACTERISTICS

HE PLUS - 460V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1162CH**	**FS1391CH**	**FS1620CH**	**FS1850CH**	**FS2081CH**	**FS2300CH**
OUTPUT	AC Output Power(kVA/kW) @50°C[1]	1160	1390	1620	1850	2080	2300
	AC Output Power(kVA/kW) @25°C[1]	1270	1530	1780	2040	2290	2550
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	460Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion(THDi)	< 3% at any load condition					
	Power Factor (cosine phi)[2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[1]	651V-900V					
	MPPt window @full power (VDC)[1]	671V–820V @50°C / 744V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Max. Power Consumption (W)	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3370x1020x2080		4400x1020x2080		5260x1020x2080	
	Weight (kg)	2500	2900	3300	3700	4100	4500
	Air Flow	Intake through rear lower part blown out through upper side					
	Type of ventilation	VSD Forced air cooling					
ENVIRONMENT	Degree of protection	Indoor IP21					
	Permissible Ambient Temperature	-20°C to +60°C					
	Relative Humidity	10% to 95% Non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level[4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App display or Web display					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDi and Isolation Monitoring Device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON/OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Wall mounted cabinets					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HE PLUS - 440V

NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1112CH**	**FS1331CH**	**FS1550CH**	**FS1770CH**	**FS1991CH**	**FS2200CH**
OUTPUT	AC Output Power(kVA/kW) @50°C[1]	1110	1330	1550	1770	1990	2200
	AC Output Power(kVA/kW) @25°C[1]	1220	1460	1710	1950	2190	2440
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	440Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion (THDi)	< 3% at any load condition					
	Power Factor (cosine phi)[2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[1]	623V-900V					
	MPPt window @full power (VDC)[1]	642V–820V @50°C / 712V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Max. Power Consumption (W)	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3370x1020x2080		4400x1020x2080		5260x1020x2080	
	Weight (kg)	2500	2900	3300	3700	4100	4500
	Air Flow	Intake through rear lower part blown out through upper side					
	Type of ventilation	VSD Forced air cooling					
ENVIRONMENT	Degree of protection	Indoor IP21					
	Permissible Ambient Temperature	-20°C to +60°C					
	Relative Humidity	10% to 95% Non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App display or Web display					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDi and Isolation Monitoring Device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Wall mounted cabinets					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HE PLUS - 420V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1051CH**	**FS1271CH**	**FS1480CH**	**FS1690CH**	**FS1901CH**	**FS2110CH**
OUTPUT	AC Output Power(kVA/kW) @50°C[1]	1050	1270	1480	1690	1900	2110
	AC Output Power(kVA/kW) @25°C[1]	1160	1400	1630	1860	2100	2330
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	420Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion(THDi)	< 3% at any load condition					
	Power Factor (cosine phi)[2]	0.00 leading ... 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[1]	594V-900V					
	MPPt window @full power (VDC)[1]	616V–820V @50°C / 680V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800W	5600W	6500W	7300W	8200W	9000W
CABINET	Dimensions [WxDxH] [mm]	3370x1020x2080		4400x1020x2080		5260x1020x2080	
	Weight (kg)	2500	2900	3300	3700	4100	4500
	Air Flow	Intake through rear lower part blown out through upper side					
	Type of ventilation	VSD Forced air cooling					
ENVIRONMENT	Degree of protection	Indoor IP21					
	Permissible Ambient Temperature	-20°C to +60°C					
	Relative Humidity	10% to 95% Non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDI and Isolation monitoring device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

TECHNICAL CHARACTERISTICS

HE PLUS - 400V

		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		**5**	**6**	**7**	**8**	**9**	**10**
REFERENCE		**FS1003CH**	**FS1201CH**	**FS1401CH**	**FS1600CH**	**FS1800CH**	**FS2000CH**
OUTPUT	AC Output Power(kVA/kW) @50°C[1]	1000	1200	1400	1600	1800	2000
	AC Output Power(kVA/kW) @25°C[1]	1110	1330	1550	1770	2000	2220
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	400Vac					
	Operating Range, Grid Frequency	50Hz/60Hz					
	Current Harmonic Distortion (THDi)	< 3% at any load condition					
	Power Factor (cosine phi)[2]	0.00 leading … 0.00 lagging adjustable / Reactive Power injection at night					
	Power Curtailment	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[1]	566V-900V					
	MPPt window @full power (VDC)[1]	584V–820V @50°C / 648V–820V @25°C					
	Maximum DC and Starting voltage	1000V					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency PAC, nom (η)	98.6%		98.6%		98.6%	
	Euroeta (η)	98.3%		98.4%		98.4%	
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
	Max. Apparent Power (VA)	4800VA	5600VA	6500VA	7300VA	8200VA	9000VA
CABINET	Dimensions [WxDxH] [mm]	3370x1020x2080		4400x1020x2080		5260x1020x2080	
	Weight (kg)	2500	2900	3300	3700	4100	4500
	Air Flow	Intake through rear lower part blown out through upper side					
	Type of ventilation	VSD Forced air cooling					
ENVIRONMENT	Degree of protection	Indoor IP21					
	Permissible Ambient Temperature	-20°C to +60°C					
	Relative Humidity	10% to 95% Non condensing					
	Max. Altitude (above sea level)	4000m; >1000m power derating					
	Noise level [4]	< 79 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display / Optional Freesun App					
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)					
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100					
	String Supervisor Communication	RS485 / Modbus RTU					
	Plant Controller Communication	Ethernet / Modbus TCP/IP					
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30VDC, 8A)					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP Grounded PV array (Positive pole and negative pole): GFDI protection PV Array transfer kit: GFDI and Isolation monitoring device (requires 1 Digital Output)					
	Humidity control	Active Heating					
	ON / OFF Pushbutton	Standard					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	Optional External Disconnecting Unit Cabinet					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC, DC Inverter and auxiliary supply type 2 - Internal Standard					
	DC Lightning Protections	Optional (Integrated in the inverter)					

[1] Values at 1.00•Vac nom and cos Φ= 1.
Consult Power Electronics for derating curves.
[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.
[3] Heating resistors kit option below -20°C.
[4] Readings taken 1 meter from the back of the unit.

SOLAR STATIONS

UTILITY SCALE
OUTDOOR AND INDOOR INVERTERS

HEM Solar inverter

MV SKID

UTILITY SCALE SOLAR STATION

TURN-KEY SOLUTION

HIGH RELIABILITY

EASY TO INSTALL

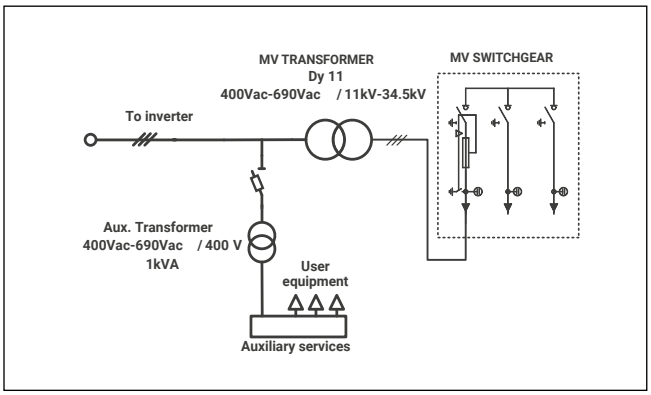
OUTDOOR DURABILITY

SIMPLIFY YOUR COMMISSIONING WITH THE MOST COMPETITIVE SOLUTION INTEGRATED WITH ALL THE MEDIUM VOLTAGE EQUIPMENT

The MV Skid is a compact turnkey outdoor platform made from high resistance galvanized steel with all the medium voltage equipment integrated, including an outdoor power transformer, MV switchgear, oil tank, filter and built in fast power connection to any HEC and HEMK solar inverter. With between 400V-460V and 565V-690V in the low voltage range and 12kV to 36kV in the high voltage range, this compact platform achieves power outputs between 1050kVA and 3800kVA when combined with the HEC and HEMK solar inverter series. This compact solution also allows the installation of a low voltage cabinet that is fully configurable to the customer needs as well as different types of cells and even an enclosure fence among other options. The MV SKID simplifies the project design of the PV plant, reducing installation costs and the amount of resources needed. The benefits of the MV Skid and the fact that it is also easier to transport and deliver into remote sites makes it the optimal solution for EPC`s (engineering, procurement and construction).

MODEL NUMBERS AND OPERATIONAL DIAGRAM

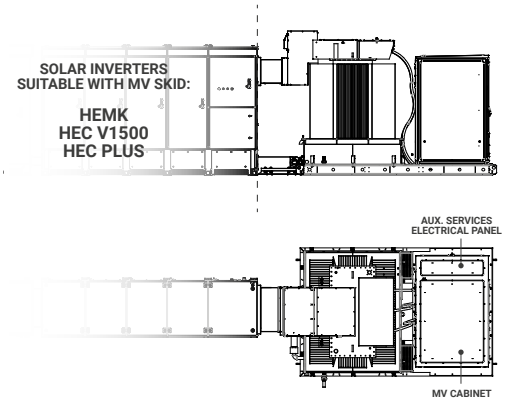
REFERENCE		RATED POWER (kVA)
FRAME 1 AND FRAME 2 [1]	MVS1050[ ]	1050
	MVS1100[ ]	1110
	MVS1220[ ]	1220
	MVS1335[ ]	1335
	MVS1440[ ]	1440
	MVS1550[ ]	1550
	MVS1630[ ]	1630
	MVS1710[ ]	1710
	MVS1800[ ]	1800
	MVS1900[ ]	1900
	MVS2000[ ]	2000
	MVS2110[ ]	2110
FRAME 2	MVS2225[L]	2225
	MVS2330[L]	2330
	MVS2440[L]	2440
	MVS2550[L]	2550
	MVS2660[L]	2660
	MVS2860[L]	2860
	MVS3000[L]	3000
	MVS3110[L]	3110
	MVS3345[L]	3345
	MVS3500[L]	3500
	MVS3630[L]	3630
	MVS3800[L]	3800



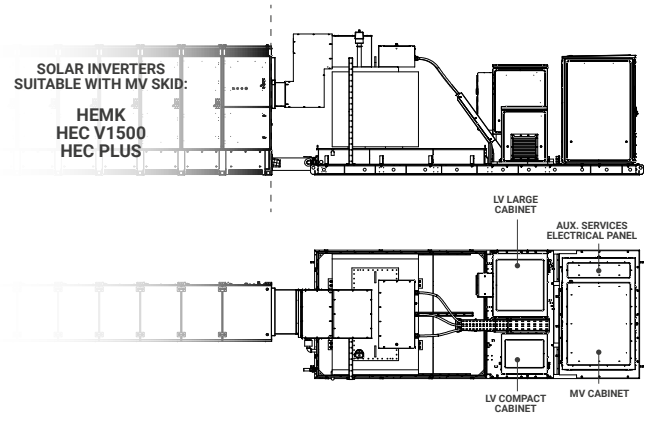
[1] Example: MVS1050S for Frame 1 / MVS10050L for Frame 2

SECTIONS

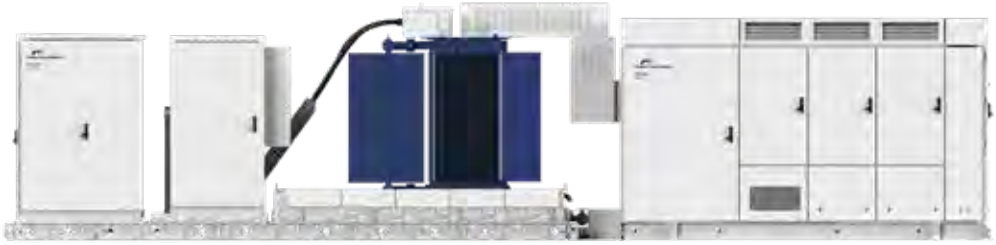
FRAME 1



FRAME 2



For customized solutions, contact Power Electronics.



TECHNICAL CHARACTERISTICS MV SKID

MV SKID		FRAME 1	
		FRAME 2	
MEDIUM VOLTAGE EQUIPMENT	Rated Power range	1050kVA - 2110kVA	2220kVA - 3800kVA
	MV Voltage range	11kV / 20kV / 22kV / 23kV / 33kV / 34.5kV	
	LV Voltage range	400V / 420V / 440V / 460V - HEC PLUS inverters 565V / 600V / 615V / 630V / 645V / 660V / 690V - HEC V1500 and HEMK inverters	
	Type of tank	Oil-sealed	
	Cooling	ONAN (KNAN optional)	
	Vector Group	Dy11	
	Transformer protection	DGPT-2 (PT100 optional)	
	Oil tank	Integrated with valve and filter	
	Transformer protection rate	IP54	
	Switchgear configuration	Single feeder (L) or Double feeder (2L)	
	Switchgear protection[1]	Fuses (P) / Automatic circuit breaker (V)	
CONNECTIONS	Inverter AC connection	Close couple solution (Plug & Play)	
	LV protection	Circuit breaker included in the inverter	
	HV AC wiring	MV Bridge between transformer and protection switchgear prewired	
ENVIROMENT	Ambient Temperature	-20°C…+50°C (t>50°C power derating)	
	Extended Temperature[2] [3]	-35°C…+50°C (t>50°C power derating)	
	Max. Altitude (above sea level)	>2000m power derating	
	Relative Humidity	4% to 95% Non condensing	
MECHANICAL CHARACTERISTICS	Skid Dimensions (WxHxD) mm	3690x2340x2235	5640x2340x2235
	Skid weight with MV equipment[1]	< 8 Tn	
	Oil tank material	Galvanized Steel	
	Skid Body material	Galvanized Steel	
	Cabinet type	Outdoor	
	Anti-rodent protection	✔	
AUXILIARY SERVICES ELECTRICAL PANEL	Auxiliary supply	3x400V, 50/60Hz	
	User power supply available	1kVA or 6kVA	
	Additional auxiliary transformer[4]	10kVA / 15kVA / 25kVA	
	Cooling	Air	
	Auxiliary supply protection	✔	
	Communication[4]	Ethernet (Fiber optic or RJ45)	
	UPS system for monitoring[4]	1kVA / 3kVA, 10 minutes	
AUXILIARY OUTDOOR TRANSFORMER	Rated Power (Voltage)	-	30kVA / 40kVA / 50kVA (3x400V)
	Cooling	-	Air
	Protection	-	Circuit breaker
	Cabinet type	-	Outdoor
LV COMPACT CABINET	Additional indoor auxiliary transf.[4]	-	10kVA / 25kVA / 40kVA / 50kVA (3x400V)
	UPS system for monitoring[4]	-	1kVA / 3kVA, 10 minutes
	Cooling	-	Air forced
	Auxiliary supply protection	-	✔
	Cabinet type	-	Outdoor
LV LARGE CABINET	Additional indoor auxiliary transf.[4]	-	25kVA / 40kVA / 50kVA (3x400V)
	UPS for trackers[4]	-	20kVA / 40kVA, 10 minutes
	Cooling	-	Air forced
	Auxiliary supply protection	-	✔
	Cabinet type	-	Outdoor
OTHER EQUIPMENT	Safety mechanism	Trapped key safety interlock	
	Safety perimeter	Transformer access protection fence	
	Cabinet heating	Heating resistors	
	Interior lighting	Fluorescent lamp	
	Emergency lighting	Electronic supplier for emergency lighting (1h autonomy)	
	Air conditioner	UPS batteries cooling	
	Communication[4]	Splice box / MV Switchgear monitoring	
STANDARDS	Medium Voltage	IEC 62271-202, IEC 62271-200, IEC 60076, IEC 61439-1	

[1] Depending on customer configuration.
[2] Optional. For additional information or available configurations, please consult Power Electronics.
[3] Other temperature range, consult Power Electronics.
[4] By demand.

TWIN SKID

UTILITY SCALE SOLAR STATION

TURN-KEY SOLUTION

HIGH RELIABILITY

EASY TO INSTALL

OUTDOOR DURABILITY

THE MOST POWER DENSE TURN-KEY STATION FOR LARGE SCALE PV PLANTS

The Twin Skid has been designed to meet the requirements of large scale PV power plants.

The solar station is a compact outdoor skid made of high resistance galvanized steel with all the medium voltage equipment integrated and acco panied by a solar inverter: protection cell, outdoor power transformer, oil tank and filter. This turnkey solution achieves power outputs between 3000kVA and 7600kVA with the HEC and HEMK solar inverter series. The Twin Skid simplifies the project design of the PV plant, reducing the cost of installation and the amount of resources needed thanks to its extra high power density.

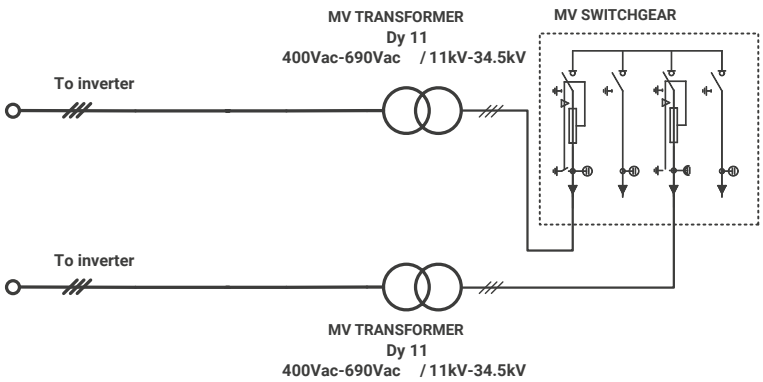
CUSTOMIZED SOLUTIONS

High value power plant projects often require customer specific solutions. Our team of highly experienced engineers are available to modify our standard solution to suit your specific demands to ensure you get the product you need.

I-TWIN SKID

U-TWIN SKID

OPERATIONAL DIAGRAM



TECHNICAL CHARACTERISTICS TWIN SKID

MEDIUM VOLTAGE EQUIPMENT	Rated Power range [1]	3000kVA - 7600kVA
	MV Voltage range	11kV / 20kV / 22kV / 23kV / 33kV / 34.5kV
	LV Voltage range	400V / 420V / 440V / 460V - HEC PLUS inverters 565V / 600V / 615V / 630V / 645V / 660V / 690V - HEC V1500 and HEMK inverters
	Type of tank	Oil-sealed
	Cooling	ONAN (KNAN optional)
	Vector Group	Dy11
	Transformer protection	DGPT-2 (PT100 optional)
	Oil tank	Integrated with valve and filter
	Transformer protection rate	IP54
	Switchgear configuration	Single feeder (L) or Double feeder (2L)
	Switchgear protection[1]	Fuses (2P) / Automatic circuit breaker (2V)
CONNECTIONS	Inverter AC connection	Close couple solution (Plug & Play)
	LV protection	Circuit breaker included in the inverter
	HV AC wiring	MV Bridge between transformer and protection switchgear prewired
ENVIROMENT	Ambient Temperature	-20°C...+50°C (t>50°C power derating)
	Extended Temperature[2] [3]	-35°C...+50°C (t>50°C power derating)
	Max. Altitude (above sea level)	>2000m power derating
	Relative Humidity	4% to 95% Non condensing
MECHANICAL CHARACTERISTICS	Skid Dimensions (WxHxD) mm [1]	8000x2340x2235 - 11000x2340x2235
	Skid weight with MV equipment [1]	< 21 Tn
	Oil tank material	Galvanized Steel
	Skid Body material	Galvanized Steel
	Cabinet type	Outdoor
	Anti-rodent protection	✔
AUXILIARY SERVICES	Rated Power (Voltage)	30kVA / 40kVA / 50kVA (3x400V)
ELECTRICAL PANEL	Cooling	Air
	Protection	Circuit breaker
	Cabinet type	Outdoor
AUXILIARY OUTDOOR TRANSFORMER	Rated Power (Voltage)	30kVA / 40kVA / 50kVA (3x400V)
	Cooling	Air
	Protection	Circuit breaker
	Cabinet type	Outdoor
LV COMPACT CABINET	Additional indoor auxiliary transf.[4]	10kVA / 25kVA / 40kVA / 50kVA (3x400V)
	UPS system for monitoring[4]	1kVA / 3kVA, 10 minutes
	Cooling	Air forced
	Auxiliary supply protection	✔
	Cabinet type	Outdoor
LV LARGE CABINET	Additional indoor auxiliary transf.[4]	25kVA / 40kVA / 50kVA (3x400V)
	UPS for trackers[4]	20kVA / 40kVA, 10 minutes
	Cooling	Air forced
	Auxiliary supply protection	✔
	Cabinet type	Outdoor
OTHER EQUIPMENT	Safety mechanism	Trapped key safety interlock
	Safety perimeter	Transformer access protection fence
	Cabinet heating	Heating resistors
	Interior lighting	Fluorescent lamp
	Emergency lighting	Electronic supplier for emergency lighting (1h autonomy)
	Air conditioner	UPS batteries cooling
	Communication[4]	Splice box / MV Switchgear monitoring
STANDARDS	Medium Voltage	IEC 62271-202, IEC 62271-200, IEC 60076, IEC 61439-1

[1] Depending on customer configuration.
[2] Optional. For additional information or available configurations, please consult Power Electronics.
[3] Other temperature range, consult Power Electronics.
[4] By demand.

HEK

UTILITY SCALE SOLAR STATION

TURN-KEY SOLUTION

HIGH RELIABILITY

EASY TO INSTALL

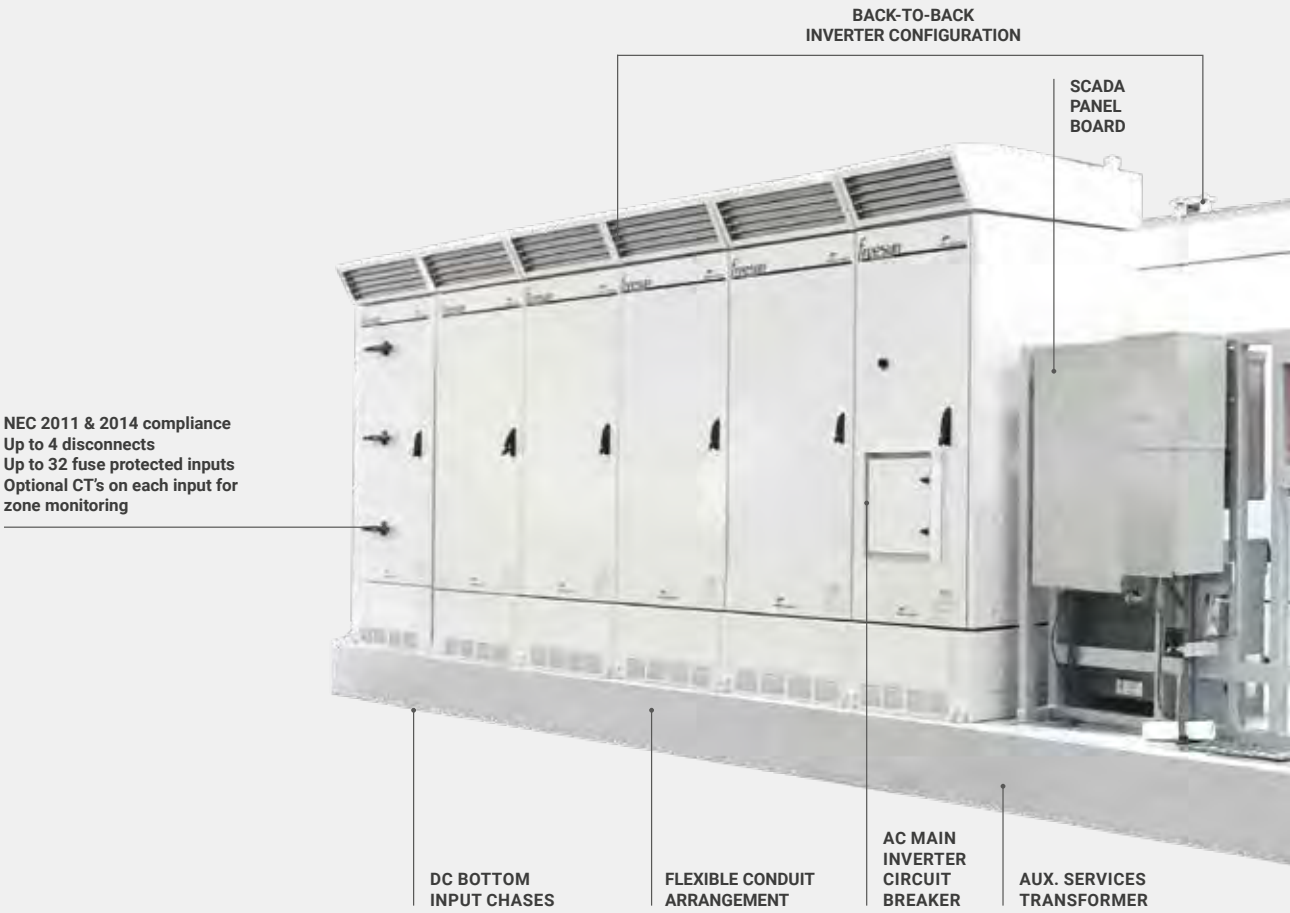
OUTDOOR DURABILITY

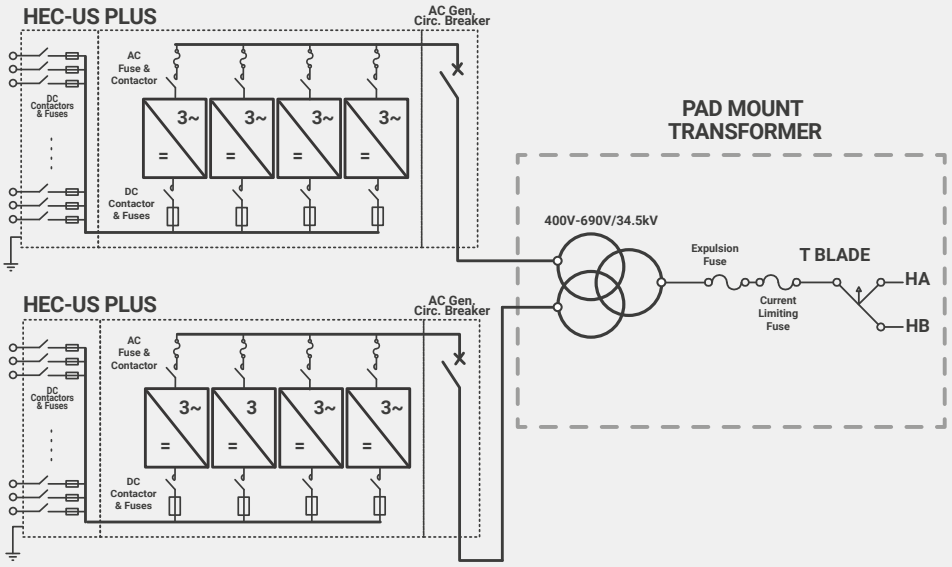
THE OPEN SKID PLATFORM OFFERS MAXIMUM YIELD AND RELIABILITY FOR SYSTEMS FROM 1MW TO 7MW

The HEK Open Skid Platforms is designed for large scale utility PV plants, with complete factory integrated DC & AC disconnects and protection, HEC-US solar inverters, step-up pad-mount transformer and auxiliary equipment. Critical power connections are completed and tested in a factory environment and the pre-tested unit is shipped to the field ready for the final connection. Standard MV skid platforms can reduce installation and commissioning time.

HEC-US inverters are equipped with the latest proven technologies which offer the maximum yield and proven reliability for utility scale projects.

TOPOLOGY


BACK-TO-BACK
INVERTER CONFIGURATION
SCADA
PANEL
BOARD
NEC 2011 & 2014 compliance
Up to 4 disconnects
Up to 32 fuse protected inputs
Optional CT's on each input for
zone monitoring
DC BOTTOM
INPUT CHASES
FLEXIBLE CONDUIT
ARRANGEMENT
AC MAIN
INVERTER
CIRCUIT
BREAKER
AUX. SERVICES
TRANSFORMER


HEC-US PLUS
AC Gen.
Circ. Breaker
AC
Fuse &
Contactor
DC
Contactors
& Fuses
3~
=
DC
Contactor
& Fuses
PAD MOUNT
TRANSFORMER
400V-690V/34.5kV
Expulsion
Fuse
T BLADE
HA
HB
Current
Limiting
Fuse
HEC-US PLUS
AC Gen.
Circ. Breaker
AC
Fuse &
Contactor
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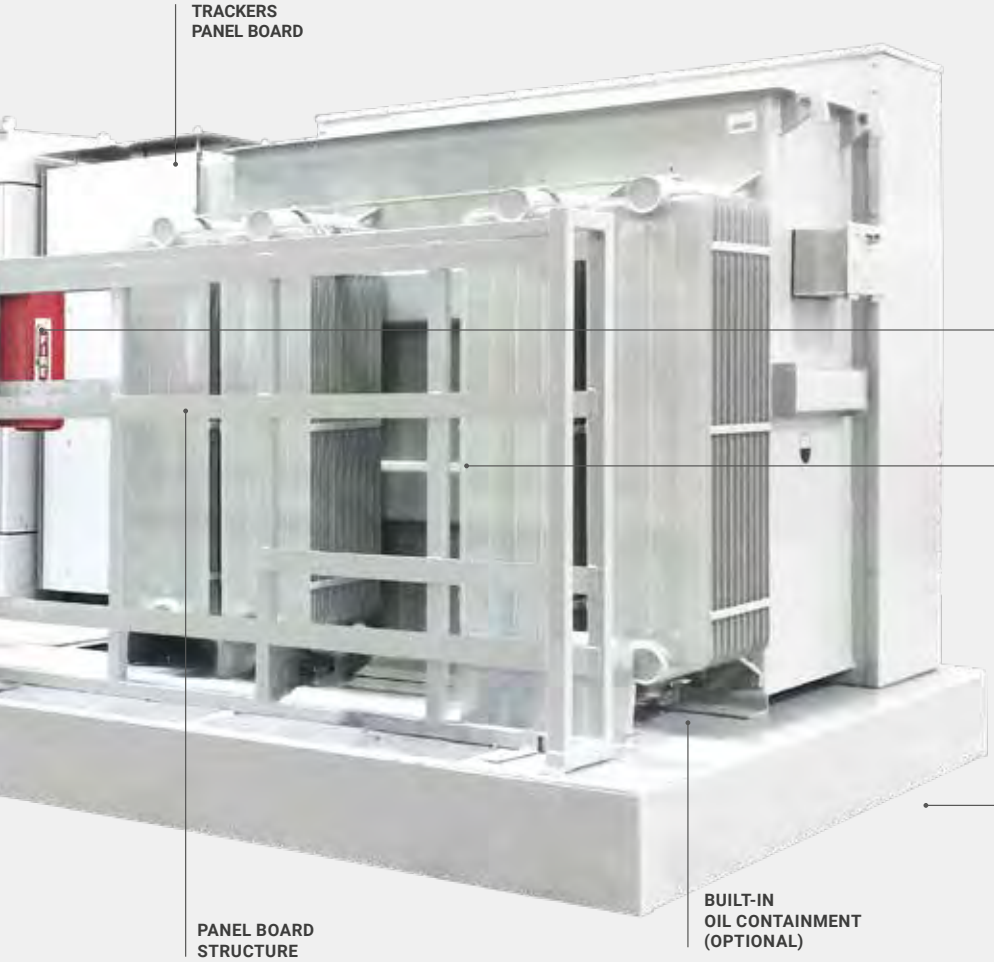
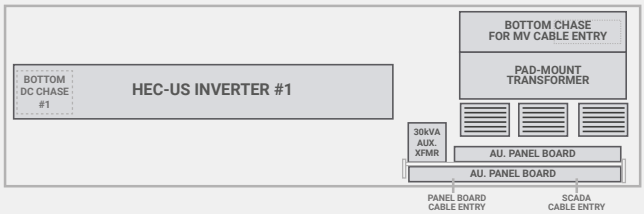
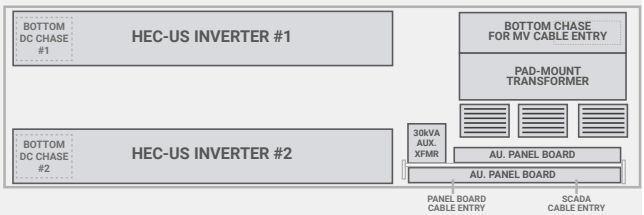


CONFIGURATIONS

1MW - 3.5MW



2MW - 7MW



[1] Other configurations, please consult Power Electronics. Some HEK units may differ from the concept shown in the images.

CONTROL AND MONITORING SOLUTIONS

FREESUN PPC
FREESUN APP
FREESUN PORTAL

PPC

UTILITY SCALE POWER PLANT CONTROLLER

Power Electronics experience in integrating its products into different global electrical networks enables us to offer a set of solutions that can be customized to your requirements to control different sources of energy into the same grid. The integration of an alternative power source creates an unprecedented opportunity to reduce operational costs to off-grid industrial and commercial facilities.

TECHNICAL CHARACTERISTICS

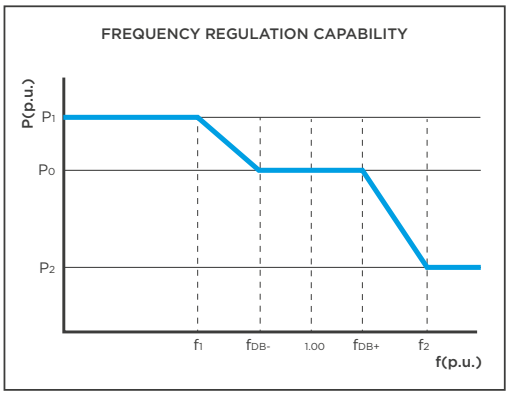
GENERAL DATA	Dimensions (WxDxH) mm	415 x 230 x 515
	Weight (kg)	10
	Mounting system	Wall mounted
	Compatible Inverters	HE, HEC, HEM, HEMK and Freemaq PCS
	Power Supply	250W
I/O and COMMUNICATIONS [1]	4 x Digital Inputs	Programmable inputs and active high (24Vdc). Optically isolated.
	1 x RS485 Port	3 wires (GND,A,B), Modbus RTU
	1 x USB Port	PC connectable using a master.Modbus configurator (ModScan or similar). Reserved for TS.
	1 x CAN Port	3 wires (LO, GND, HI), Modbus RTU
	1 x Ethernet Port (RJ45)	Modbus TCP/IP
ENVIRONMENTAL CONDITIONS	Operation Temperature	0~50°C (32°~122°F)
	Storage temperature	-20~80°C (-4°~176°F)
	Humidity	5-95% non-condensing
	Degree of protection	IP42
CERTIFICATIONS	CE	
OTHERS	Web interface for local and remote monitoring	
	Customized solution	

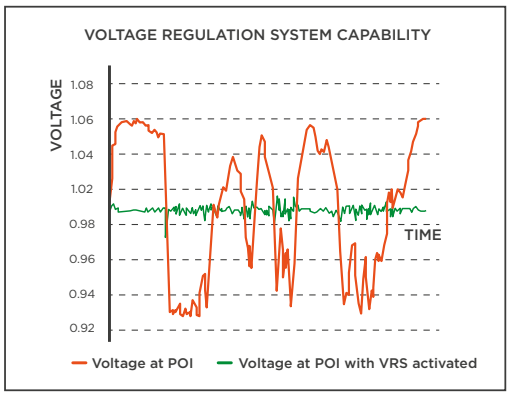
[1] Communication ports can be customised depending on PV plant design without prior notice.

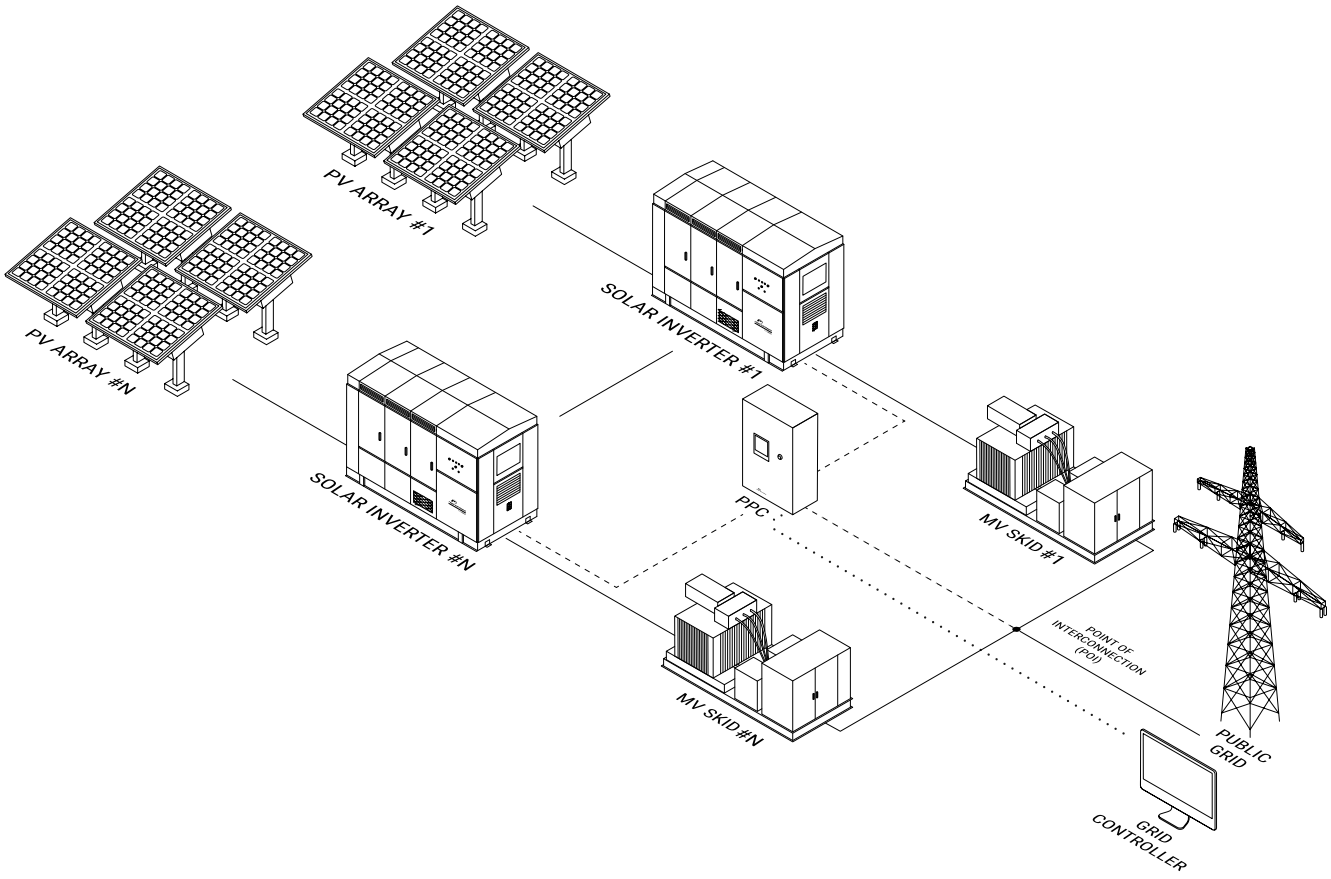
DYNAMIC GRID SUPPORT

The Power Electronics Power Plant Controller is a device used to manage PV plants in order to comply with all the utility and customer requirements, thanks to its fast and flexible control algorithms. The PPC helps the grid controller to manage the performance of the PV plant, guaranteeing grid quality requirements.

The PPC includes the latest utility interactive specifications to support the grid, by controlling the reactive and active power at the POI with a fast response time. This flexible plant control device allows the user to customize the unit, in order to comply with any grid code standards and regulations.



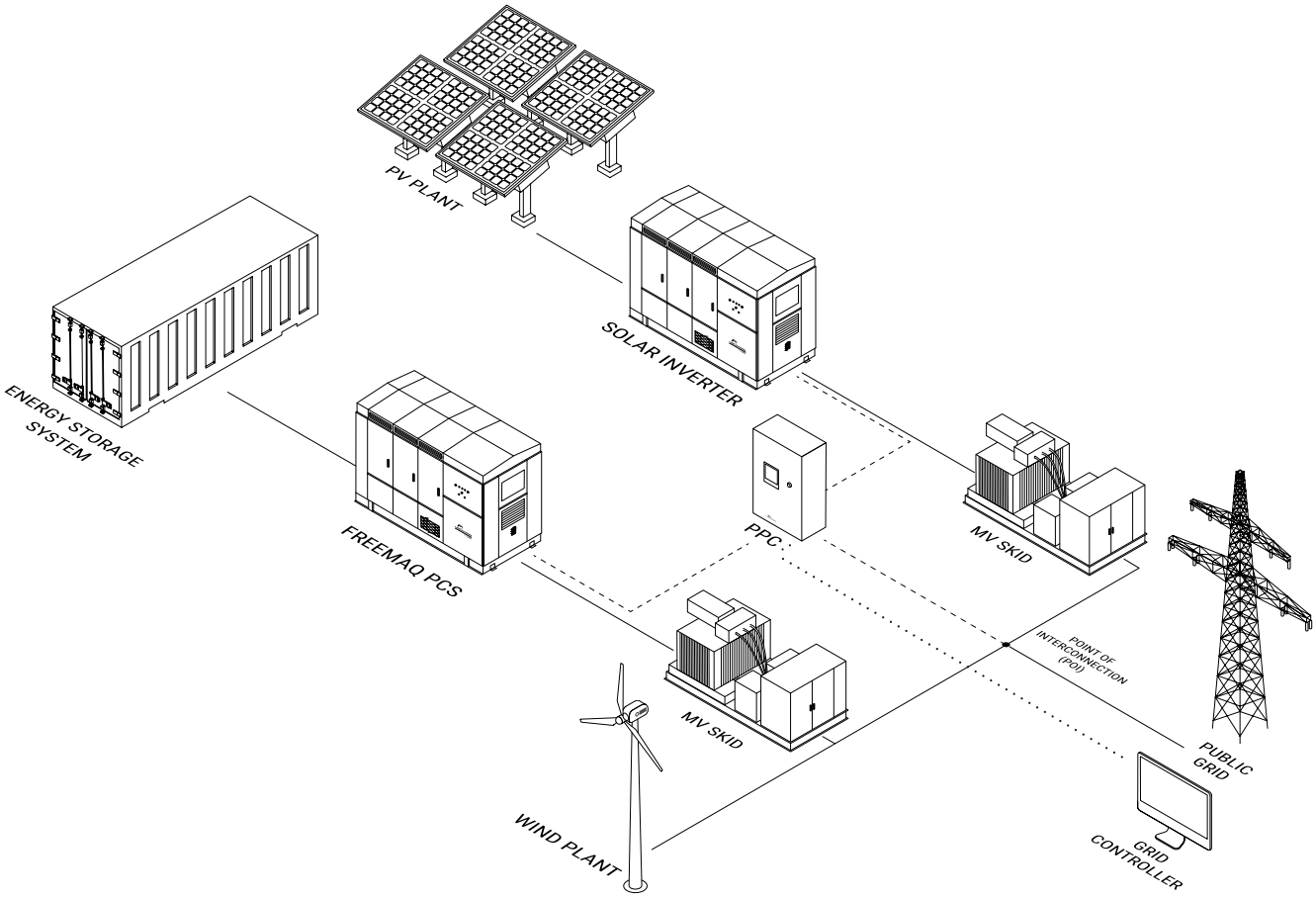




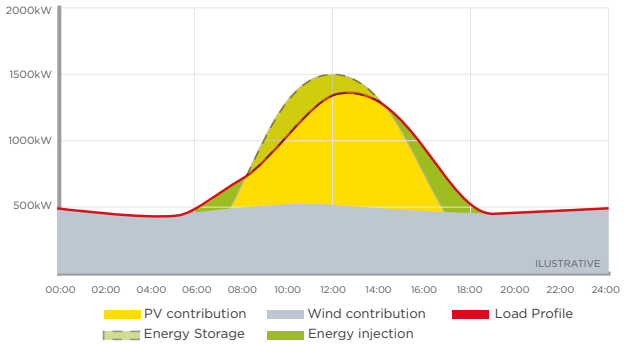
POWER PLANT CONTROLLER

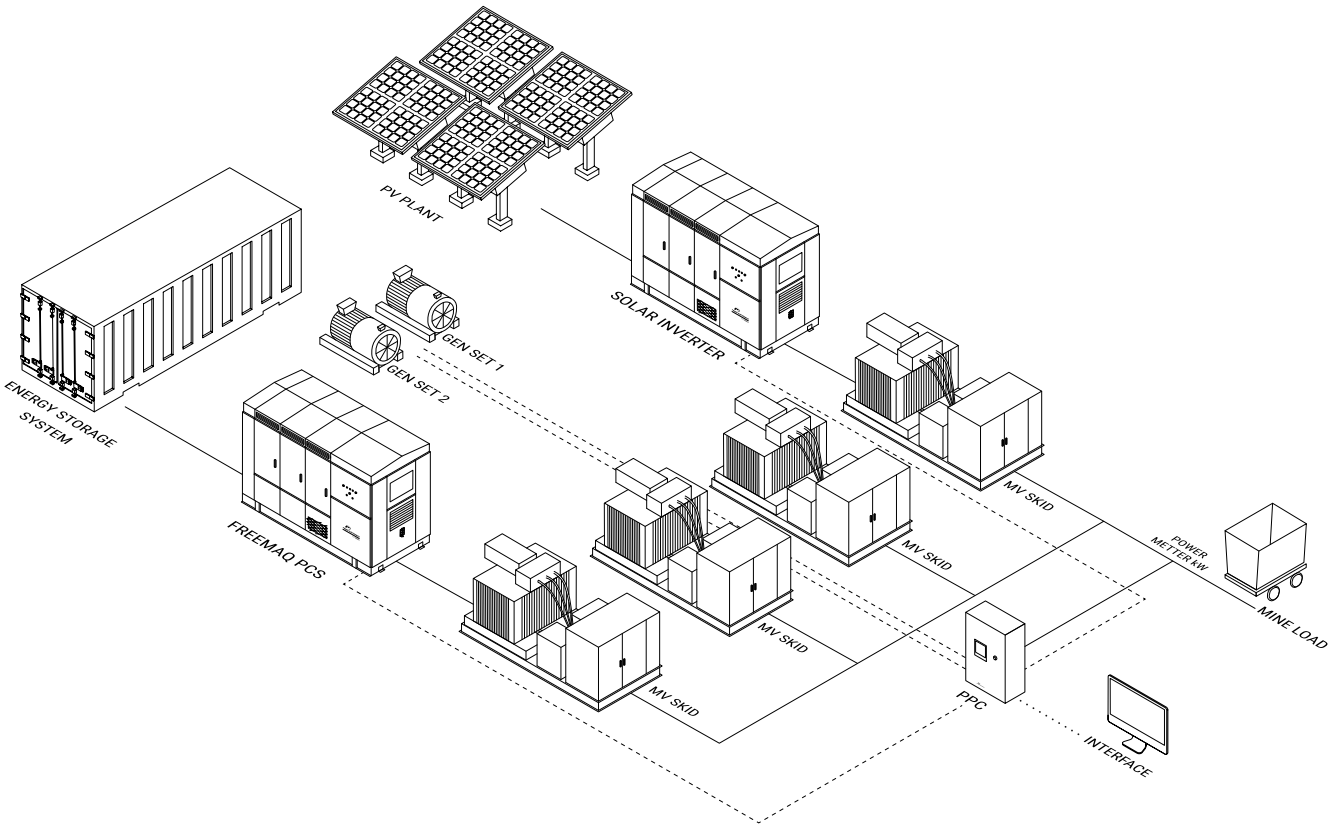
The Power Plant Controller (PPC) can be the main governor of the most complex Multi PCS systems by monitoring the point of interconnection (POI) and at the same time controlling the power generation and storage equipment.

The PPC is equipped with the latest PLC based microprocessor that interacts through the programmable digital/analogue signals and communication ports (Modbus TCP). The PPC together with the Freesun solar inverter or the Freemaq series can be customized for those countries (Puerto Rico, Hawaii….) that require full compliance to stringent dynamic grid support response at POI.

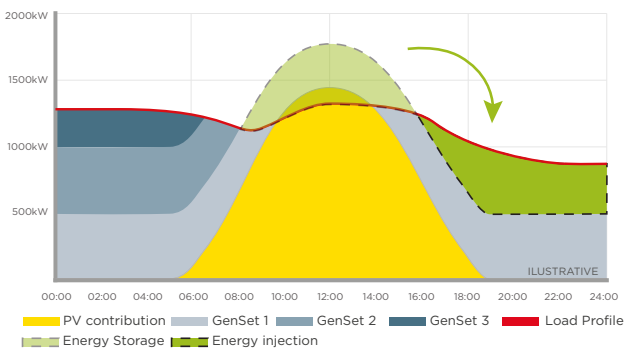


- PPC main governor and interface of the system.
- Multiple renewable power sources: solar, wind, etc.
- Centralized dynamic grid support at POI.
- Power smoothing – Enable ramp rate control.
- Storage equipment control.





- PPC main governor and interface of the system.
- Multiple GenSets and storage equipment control.
- Centralized dynamic grid support at POI.
- Power shaping - Enhanced broad implementation of decentralized PV.
- Power smoothing – Enable ramp rate control.



FREESUN PORTAL

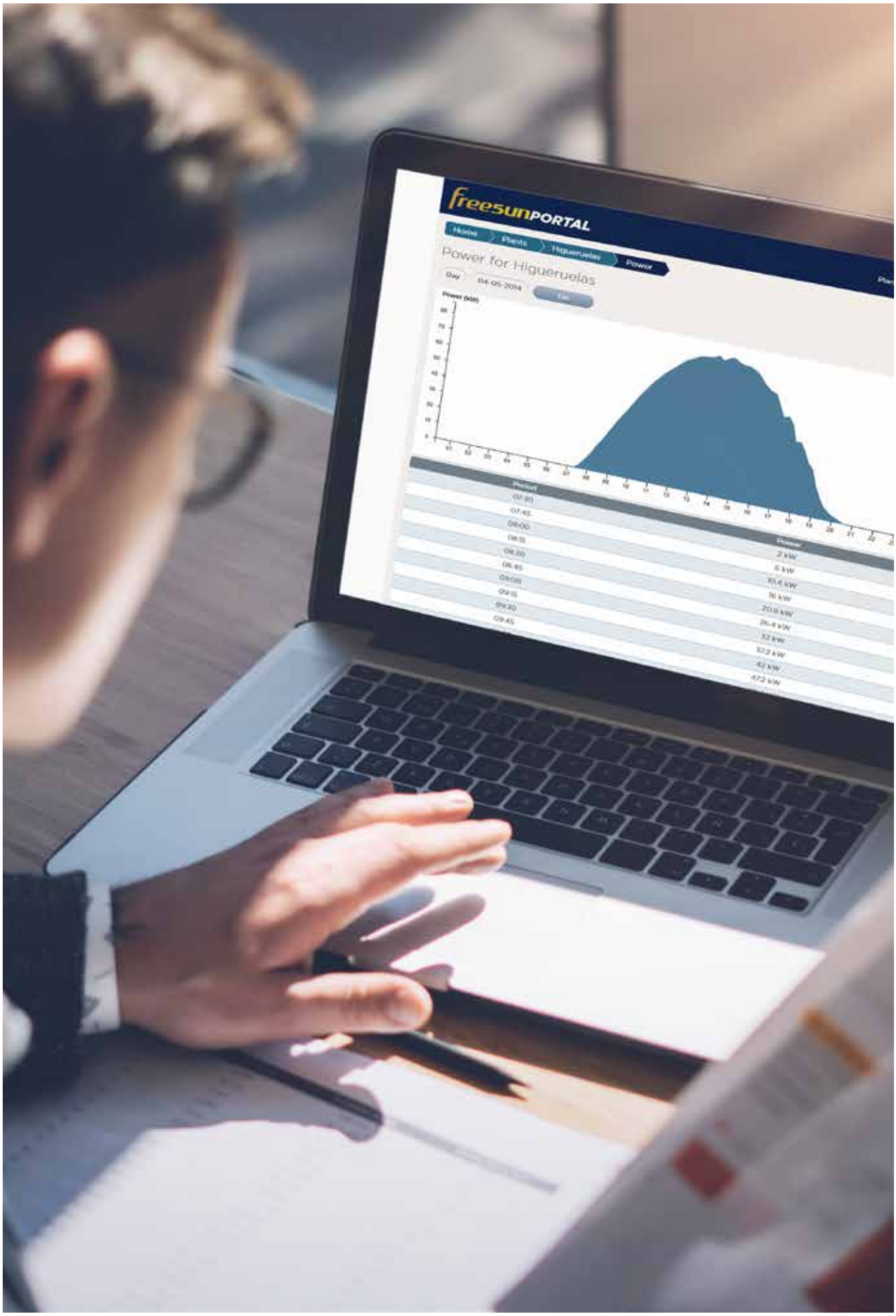
GO ONLINE

The Freesun Portal is an attractive and comprehensive monitoring tool available in one click through a free web service. The data sent by the Datalogger is stored in the Power Electronics Database and meaningfully plotted or exported. EPC´s or end user can easily check all the data retrieved from the inverter, in real time, anywhere in the world and on any device.

The system refreshes the data every minute showing an accurate and comprehensive status of your PV facilities.

The data is stored in a secure database where multiple PV plants can be monitored at the same time by multiple users in multiple locations. The web application allows you to introduce plant information, to select multiple charts or plot intervals for the creation of daily, monthly or annual reports, and to export data in xls and pdf files.

WEBSITE ACCESS	www.freesunportal.com
AVAILABLE INFORMATION	Inverter and module status. Inverter and module Power (kW). Daily Energy (kWh). Total Energy (MWh). Inverter current (A). Inverter and Module faults. Others available.
FEATURES	Comprehensive and flexible charts Annual, Monthly, daily reports. Generation of historic data tables Historic data exportation XLS. Files Multiple user licences and administrator capabilities
LANGUAGE	English, Spanish.
SYSTEM REQUIREMENTS	Internet Explorer 8. Firefox 5. Google Chrome 14. Safari 5. Opera 11. Java Script. Cookies Activated.


freesunPORTAL
Home
Plants
Higueruelas
Power
Power for Higueruelas
04-05-2014
Power (kW)

FREESUN APP

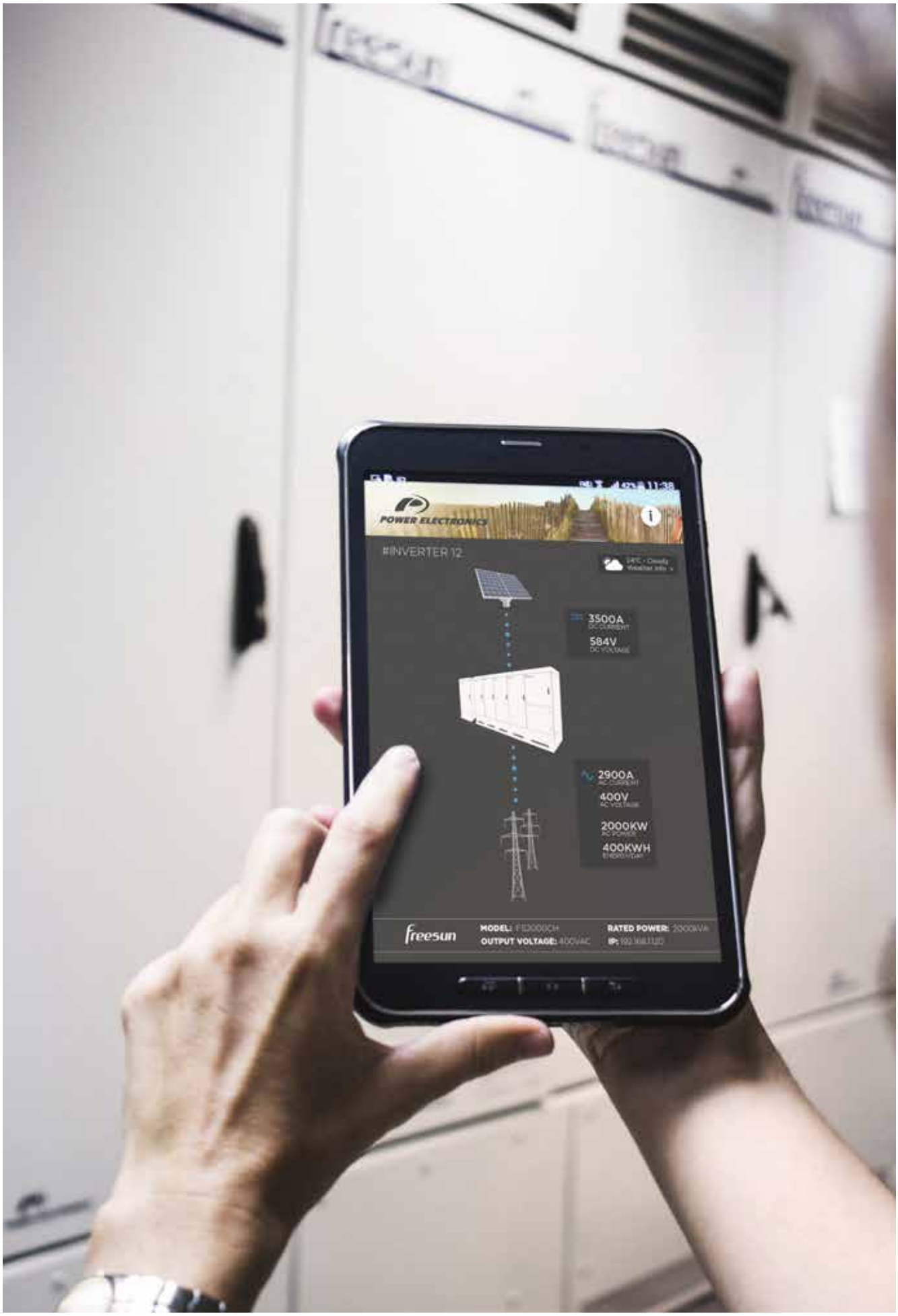
GO WIRELESS

The ultimate APP display application will play a key role in your Plant Service and Management. Any Android or iOS device can easily wirelessly connect to the inverter for a comprehensive and user friendly interface. Forget about using built-in displays with tiny screens or tedious menus, and allow your field technicians to service outdoor units in rain, snow or sun scorching conditions, without opening or standing in front of the unit. In its bid to create an application for mobile devices Power Electronics presents our Freesun app for monitoring our solar inverters. It is available on Android and iOS operating systems and can be used on both smartphones and tablets.

The Freesun application makes it easy to connect to our modular solar inverters via wifi. It is possible to perform the following tasks: monitor the key performance parameters of equipment, monitor operating statuses of diagnostics, module comparisons, values of incidents and many more.

The application, through a careful and simple interface, displays data graphically and numerically. It also provides comparative information at the level of modules as well as showing detailed information of the entire system. Easy and intuitive to use; with this application you can automatically identify Freesun solar inverters available on the local network and store information from inverters to communicate with them at any time.

AVAILABLE INFORMATION	Grid and PV field data. Inverter and Power module data (Voltages, currents, power, temperatures, I/O status...). Weather conditions. Alarms and warnings events. Energy registers. Others.
FEATURES	Easy Wireless connection. Comprehensive interface. Real time data. Save and copy settings.
LANGUAGE	English, Spanish.
SYSTEM REQUIREMENTS	iOS or Android devices.
SETTINGS CONTROL	Yes


POWER ELECTRONICS
#INVERTER 12
3500A
584V
2900A
400V
2000KW
400KWH
freesun
MODEL:
OUTPUT VOLTAGE:
RATED POWER:

REFERENCES

More than 12GW installed around the world.

BRAZIL

BRAZIL´S 1ST 1500V INVERTER

Sobral and Sertao, 30+30MW

HEC V1500 + MV SKID

ARGENTINA

ARGENTINA'S 1ST 1500V INVERTER

Nonogasta, 42MW

HEC V1500 + TWIN SKID

CHILE

Santiago Solar, 115MV

HEC PLUS + MV SKID

UNITED STATES

Selmer I-II, 14MW

HEC-US V1500

UNITED STATES

Maverick, 8.5MW

HEC-US V1500

UNITED STATES

Roserock, 157MW

HEC-US

MEXICO

Santiago & Hermosillo, 170+100MW

HEC V1500 + MV SKID

IRELAND

Dale Farm, 4MW

HEV 1500 + MV SKID

UNITED KINGDOM

Eveley, 49MW

HEC PLUS

UNITED STATES

Huzlehurst, 52MW

HEC-US V1500

JAPAN

Tano Ike, 2.5MW

HEC V1500

JAPAN 1ST 1500V INVERTER

UNITED KINGDOM

Lyneham, 51MW

HEC PLUS

UNITED STATES

Payne, 105MW

HEM

PANAMA

Chiriqui, 10.5MW

HEC PLUS

MAURITANIA

Zouerate, 3MW

HET

JORDAN

Al Mafraq, 61MW

HEC V1500 + MV SKID

JORDAN´S 1ST 1500V INVERTER

CHILE

Uribe, 50MW

HEC PLUS + MV SKID

UNITED STATES

San Bernardino, 30MW

HEK

UNITED KINGDOM

West Raynham, 44MW

HEC PLUS

PORTUGAL

Ourique, 46MW

HEC V1500

PORTUGAL'S 1ST 1500V INVERTER

BOLIVIA

Uyuni & Yunchara, 60+5MW

HEC V1500 + MV SKID

BOLIVIA 1ST 1500V INVERTER

CHILE

Los Andes, 24 MW

HEC PLUS

URUGUAY

Alto Cielo, 26MW

HEC PLUS

BARBADOS

St. Lucy, 9MW

HEC PLUS

UNITED STATES

Gala, 56MW

HEC-US V1500

UNITED STATES

Calflats, 280MW

HEC-US

MEXICO

Solem I & II, 175 + 165 MV

HEC V1500 + MV SKID

UNITED STATES

Oak Solar, 180MW

HEC-US V1500

AUSTRALIA

Barcaldine, 20MW

HEC PLUS + MV SKID

UNITED STATES

Portal Ridge, 32MW

HEC-US V1500

WARRANTY

Power Electronics (the Seller) warrants that their SOLAR INVERTER Products are free of faults and defects for a period of 5 years, valid from the date of delivery to the Buyer. It shall be understood that a product is free of faults and defects when its condition and performance is in compliance with its specification.

The warranty shall not extend to any Products whose defects are due to (i) careless or improper use, (ii) failure to observe the Seller's instructions regarding the transport, installation, functioning, maintenance and the storage of the Products, (iii) repairs or modifications made by the Buyer or third party without prior written authorization of the Seller, (iv) negligence during the implementation of authorized repairs or modifications, (v) if serial numbers are modified or illegible, (vi) anomalies caused by, or connected to, the elements coupled directly by the Buyer or by the final customer, (vii) accidents or events that place the Product outside its storage and operational specification, (viii) continued use of the Products after identification of a fault or defect.

The warranty excludes components that must be replaced periodically such as fuses, lamps & air filters or consumable materials subject to normal wear and tear.

The warranty excludes external parts that are not manufactured by the Seller under the brand of Power Electronics.

The Seller undertakes to replace or to repair, himself, at their discretion, any Product or its part that demonstrates a fault or defect, which is in conformance with the aforementioned terms of the warranty. Reasonable costs associated with the disassembly/assembly, transport and customs of equipment will also be undertaken by the Seller except in cases of approved intervention by the Buyer and/or their representative where cost allocation has been previously agreed. In case of fault or defect, the Buyer shall notify the Seller in writing by using the following contact email: quality@powerelectronics. com, of the presence of any fault or defect within 15 days of the fault or defect event. The serial number of the defective product plus a brief description of the fault must be included in the email. Failure to notify the Seller of fault or defect within this time period may result in the warranty becoming invalid.

In the event of replacement of defective Product or part thereof, the property of the Product or part shall be transferred to the Seller.

The Seller shall bear no liability for damages to property or third persons, even as manufacturer of the Products, other than that expressly provided by virtue of applicable mandatory law provisions. In any case, the Seller shall not be liable for indirect or consequential damages of whatsoever nature as, by way of example, production losses or unearned profits.

The Seller shall, at their discretion, forfeit all warranty rights of the Buyer if the total sum of the contract and payment has not been reached in accordance with the agreed conditions of the contract.

No other warranties, express or implied, are made with respect to the Products including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose.

In any case, the Buyer's right to damages shall be limited to a maximum amount equal to no more than the price obtained by the Seller of the faulty or defective Products.

These conditions shall apply to any repaired or replacement products. Not withstanding the above, the replacement of a Product does not imply an extension of the term of warranty outside that of the original term.

ADDITIONAL WARRANTY

Power Electronics stands by the quality and durability of our inverters. That is why we offer a comprehensive 5 year warranty on our equipment. As the inverter is the critical component of the installation, it must not shutdown.

This is why we have made it our top priority to create a robust and reliable product and give the best service and warranty along with it. To boost your confidence further in our products, Extended Warranty packages up to 20 years are also available.

HEADQUARTERS

SPAIN

C/ Leonardo da Vinci, 24 - 26

Parque Tecnológico, 46980.

Paterna - Valencia. - Spain.

Tel. 902 40 20 70

Tel. (+34) 96 136 65 57

Fax (+34) 96 131 82 01

INTERNATIONAL SUBSIDIARIES

AUSTRALIA

sales@power-electronics.com.au

Tel. (61) 7 3386 1993

BRAZIL

comercialbrasil@power-electronics.com

Tel. (+55) 11 5891 9612

CHILE

ventaschile@power-electronics.com

Tel. (+56) 9 8587 4347

CHINA

sales@power-electronics.com.cn

Tel. (+86 10) 6437 9197

COLOMBIA

ventascolombia@power-electronics.com

Tel. (+57) 322 3464855

FRANCE

ventesfrance@power-electronics.com

Tel. +33(0)1 46 46 10 34 Ext. 1034

GERMANY

info@ped-deutschland.de

Tel. (+49) 911 99 43 99 0

INDIA

salesindia@power-electronics.com

Tel. (+91) 80 6569 0489

ITALY

infoitalia@power-electronics.com

Tel. (+39) 342 50 73 691

JAPAN

salesjapan@power-electronics.com

Tel. (+81) 80 9386 6107

KOREA

sales@power-electronics.kr

Tel. (+82) 2 3462 4656

MEXICO

ventasmexico@power-electronics.com

Tel. (+52) 1 55 2653 3738

NEW ZEALAND

sales@power-electronics.co.nz

Tel. (+64 3) 379 98 26

PERU

ventasperu@power-electronics.com

Tel. (+51) 979 749 772

UAE

middleeast@power-electronics.com

Tel. +971 4 364 1200

UNITED KINGDOM

uksales@power-electronics.com

Tel. (+44) 149 437 00 29

UNITED STATES

sales@power-electronics.us

Tel. (+1) 602-354-4890

POWER ELECTRONICS®

FSCA02KI

POWER ELECTRONICS®

POWER-ELECTRONICS.COM